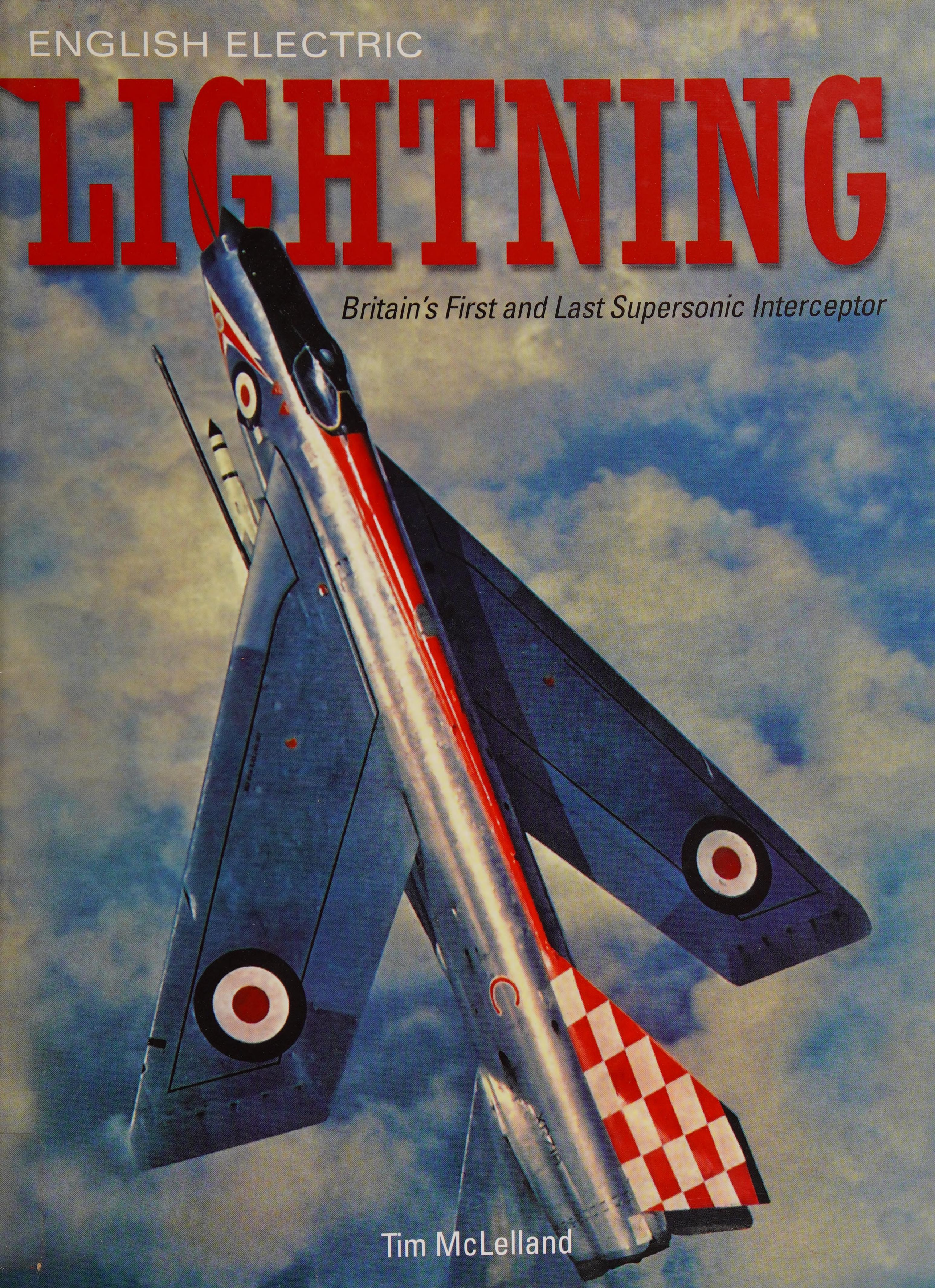
ENGLISH ELECTRIC

LIGHTNING

Britain's First and Last Supersonic Interceptor



Tim McLelland

The English Electric Lightning was a triumph of post-war aviation technology. Developed and manufactured during years of national austerity, the Lightning was Britain's answer to a growing threat from beyond the Iron Curtain where the Soviets were busy creating a sizeable force of supersonic bombers, all of which had the capacity to reach and destroy targets in the United Kingdom. Having emerged from the hard lessons of World War 2, the Royal Air Force was faced with a completely new threat and a drastically different era of capability and technology. The days of lumbering piston-engine bombers and fighters were over and the jet age had truly arrived. However, jet technology was in its infancy, as was the aerodynamic knowledge which was badly needed in order to take advantage of projected increases in power and speed, therefore it is all the more remarkable, that while the RAF was consolidating its defensive capability around the almost pedestrian types such as the Meteor and Vampire, attention was being shifted to a new jet interceptor which would be capable of achieving supersonic speeds in level flight. The result was an aircraft which could more than comfortably meet this aim and the RAF was ultimately blessed with what was undoubtedly one of the finest fighter aircraft ever built. Capable of staggering altitude performance and with a top speed in excess of twice the speed of sound, the Lightning was an outstanding aircraft.

However, the Lightning's story is not a tale of shining success. Dogged by political short-sightedness, the aircraft's true potential was never realised and every opportunity to develop the aircraft's capabilities was met by cost-cutting, backward thinking and hopelessly optimistic conceptions of all-missile defences which would supposedly render the Lightning redundant. Ironically, the Lighting was always regarded as a short-term solution to Britain's air defence needs even though it soldiered-on for decades and proved to be an invaluable asset. Much loved by all those who were fortunate to fly it, often hated by everyone who maintained and serviced it, the Lightning was a true icon of the Cold War era. The first and last all-British supersonic interceptor, the Lightning was truly unique.

Tim McLelland places the Lightning in context, covering its design, development and operational history. His research is underscored by dramatic photographic reference and superb colour profile artwork. This book is one of the most comprehensive studies of the English Electric Lightning yet produced.

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LIGHTNING

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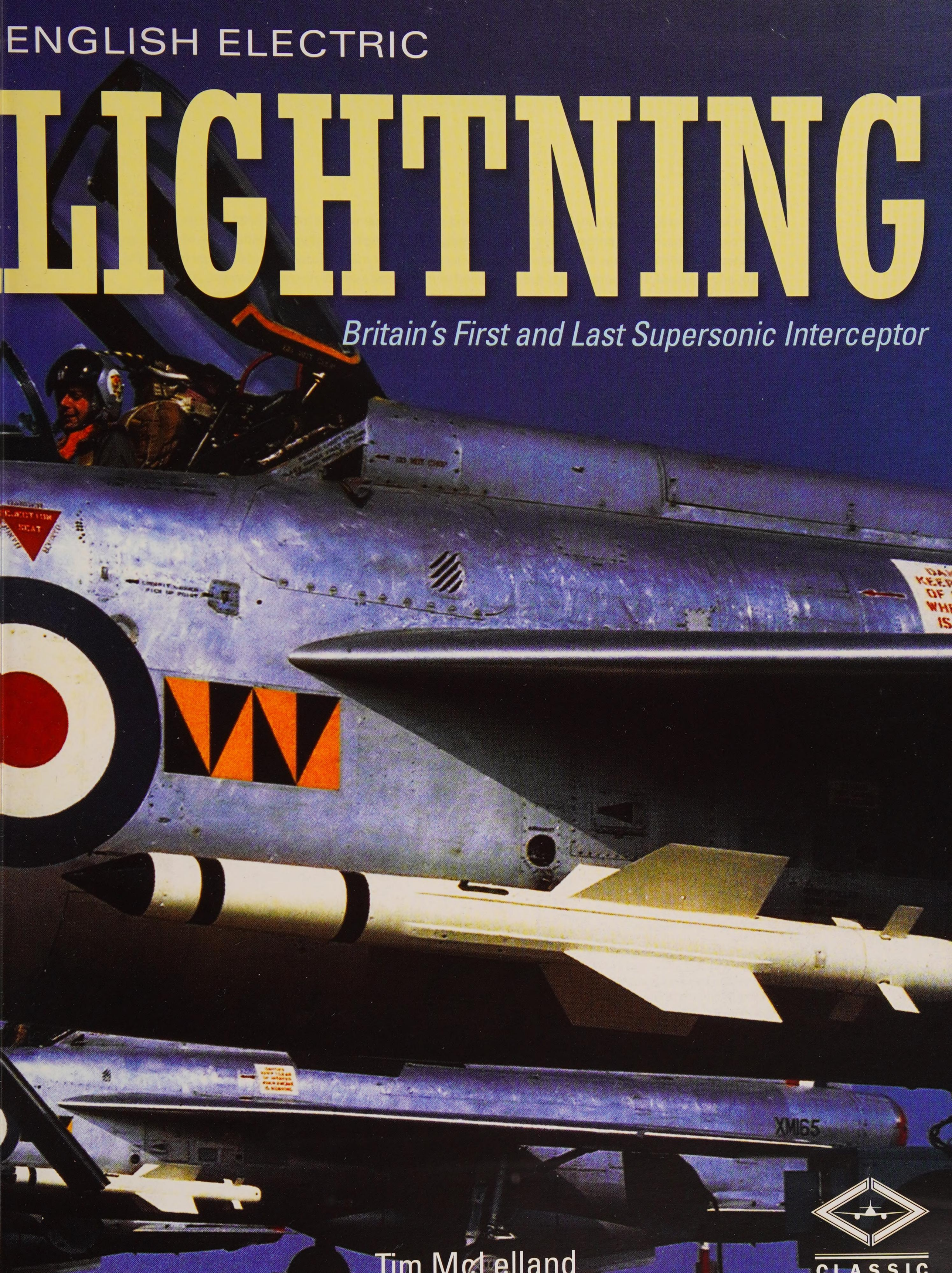
WHEN ENGINE IS RUNNING

KEEP CLEAR WHEN
ENGINE IS RUNNING

ENGLISH ELECTRIC

LIGHTNING

Britain's First and Last Supersonic Interceptor



Tim McLelland

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The Author

Tim McLelland is an established aviation writer and photographer with an interest in all aspects of aerospace, specialising primarily in post-war military subjects. He has authored a wide range of books on a variety of subjects. He has also produced numerous features for many aerospace publications both in the UK and overseas. His contributions have appeared in magazines such as *Aircraft Illustrated, Air Extra, Armed Forces, Air Forces Monthly, Flypast, Aviation News* and many other well-known titles. He also edited *Air Forces International* magazine, and *Scale Models* magazine, in addition to the house magazine of the International Plastic Modellers Society (UK).

As part of his photography and writing work, Tim McLelland counts himself fortunate to have been afforded a great deal of direct access to military units around the world, talking to serving air crew and staff officers on all aspects of operational and training activities. He also regards himself as being particularly fortunate to have been given many opportunities to fly as passenger in a wide range of combat aircraft, enabling him to see first-hand what military flying is all about. His 'log book' includes types such as the Jaguar, Lightning, Harrier, Tornado fighter and bomber, Hawk, Hunter, F-4 Phantom (both in US and British service), Buccaneer, Nimrod, Canberra, Hercules, VC10, Chinook, and many others, as well as historical types such as the Lancaster and Shackleton and a number of flights with the world-famous Red Arrows, and the US Navy's Blue Angels team.

Away from the world of military operations, Tim McLelland also worked with Channel 4 Television, as a stills photographer, on the *Treasure Hunt* and *Interceptor TV* series.

His published works include *Buccaneer, Vulcan – A Complete History, The RAF Manual, Fighter Pilot, Tiger Meet, Flying Tankers, Hunter – A Complete History, Avro Vulcan, Fight's On* and *C-130 Hercules.*

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Introduction and Acknowledgements

The magnificent, awe-inspiring Lightning. Loved by all those who were fortunate to fly it, often hated by those who had to maintain it, and still a source of fascination for historians and enthusiasts both in the UK and around the world. A fantastic Mach Two fighter born in the 1950s and still possessing a performance which would leave many modern aircraft breathless – even now, fifty years later.

This book is the latest in a long line of Lightning books which have appeared over many years and although the subject certainly is not new, the Lightning is more popular than ever, and so I was delighted to have an opportunity to explore one of Britain's finest creations.

More than a few people rolled their eyes skywards when I mentioned that I was writing yet another Lightning book, but deep down we all know that there will never be too many Lightning books. The subject is just too popular to leave alone for long. This time, I have endeavoured to create a truly comprehensive study of the Lightning, combining a look at the aircraft's origins, the design and development process, through to the different variants which were produced, together with a complete listing of every Lightning built.

I have also devoted a significant part of the book to the people who know much more about the Lightning than I ever will – the men who actually worked with the aircraft and flew the great 'beast' during its days with the Royal Air Force. Their first-hand accounts do much more than any historical account ever could, to explain what it's really like to be there, up-close at the 'business end' of things. Combined with all this is a broad and varied selection of photographs showing the Lightning in as many guises as possible and at all stages of the aircraft's history, from the factory floor through to the museum exhibits which still survive today.

Finally, for the technically-minded (and for the model builders out there – of which I am one) I have also included a detail reference section which includes close-up photographs and drawings taken directly from the original aircraft manuals, plus a set of superb scale drawings and some beautiful colour profiles showing some of the Lightning's many eye-catching colour schemes. I hope that this assemblage is enough to keep even the most demanding Lightning aficionado happy and that this book will serve as an entertaining and informative celebration of one of the RAF's most iconic aircraft.

Of course, a book of this nature relies on the support of many individuals who never seem to tire of my endless pleas for information and pictures. As ever, I am extremely grateful to everyone who gave so freely of their time to add something to this project. I would probably need a whole chapter to mention everyone but I am sure that all those who have helped know who they are and that their efforts are greatly appreciated. However I must say a specific 'thank you' to the following people whose help has been pivotal to the success of the project:

Terry Senior, Paul Tomlin, Ken Goodwin, Peter Collins, Craig Penrice, Sir John Severne, Terry Kinglsey, Ian Hartley, John Carter, Colin Wilcock, Rob Hilton, John Blakeley, Alan Lane, Richard Caruana, Craig Jackson, Ian Black, John Davidson, Kev Daws, Eric Steenson, Andy Bonsell, Max Waldron, Taffy Holden, Peter Arnold, Glenn Sands, Ray Deacon, Alan Southcombe and Dick Lohuis.

Thanks guys!

Tim McLelland

Sheffield

2009

(Photo: Terry Senior)

HAVING been born in the 1960s and being obsessed with aeroplanes for as long as I can remember, it's fair to say that I grew up with the Lightning. My first memories of any aircraft were of the Battle of Britain At Home days held at my local RAF station at Finningley, the annual open day being the highlight of my year when it was possible to spend a whole day just absorbing the sights, sounds and smells of aircraft. It was a heady mix of excitement, noise, speed, spectacle, kerosene and hot dogs which held me spellbound. The aerobatics were fine, the Spitfires and Hurricanes were interesting, but when you're just a kid it's all about noise, so the traditional Vulcan scramble was always the highlight of the show, just for the sheer thrill of feeling the ground shake as the dark, camouflaged monsters roared by. But there was always another highlight too – the sleek, shiny and almost brutal-looking jet fighter that was usually tucked away in a far corner of the airfield where the flying display aircraft rested between performances. When you saw the big silver tail fin slowly moving by above the crowds of spectators it was time go grab a good vantage point for the star performer. You knew it was coming though, since the first task of the show day was to check the display programme for the bits that you didn't want to miss. In those days there wasn't much of a list to read as the flying display generally lasted only two or three hours at the most, so it took only a few seconds to thumb down the paper to find what you were really looking for – the Lightning. Of course it never failed to impress. Glistening silver metalwork, big bright roundels and a splash of heraldry on the tail, two big and very serious-looking missiles strapped to her sides, swept-back wings, and a fierce nose complete with a long, pointed probe at the tip. It looked every inch a fighting machine. Once into the air, the Lightning more than lived-up to a child's expectations. It seemed to perform effortlessly through loops, rolls, slow passes with her clumsy-looking landing gear extended, and low, fast passes accompanied by a plume of reheat flame, a terrifying cloud of water vapour and a gratifying, ear-splitting blast of noise which (as the great Sir Douglas Bader once said) almost encouraged you to cover your ears and stick your head under the nearest seat. But for a kid who was obsessed with aeroplanes it was different – I just wanted to stand there and enjoy the thrill, my senses battered by the noise, and when the Lightning made the final near-supersonic rush into a final vertical departure I was truly spellbound, watching as the great machine thundered higher and higher until it disappeared into the glare of the sky. Things just didn't get any better than that. Back in those days I never imagined even for a minute that one day I would be able to climb into a Lightning and go fly. Why would I have? Lightnings were almost mythical creatures that performed their mysterious business tantalisingly out of reach beyond crowd barriers and perimeter fences. They were strange and beautiful machines, handled by a special breed of men – superheroes dressed in their bizarre space suits. And yet, a decade or so later, there I was, high on top of the Lincolnshire wolds, standing face to face with the magical monster – and it was inviting me to come inside.

Of course I count myself as being very lucky. Not only for the opportunity but for getting there just in time. It was 1987 and the Lightning was on the verge of retirement from Royal Air Force service. The days of pristine, gleaming silver jets had long gone and in front of me was something which seemed so very different from the aeroplane I remembered from my childhood. It didn't glitter at all – it was just plain dirty. The shiny metalwork was all gone, replaced by a dark and gloomy mix of green and grey camouflage which had obviously been applied to the aircraft for many years, the mismatch of camouflage lines revealing where access panels had been continually removed and replaced, some from different aircraft with slightly different colours, and most of them covered with scratches and streaks of dirt, their edges worn and chipped. Patches of fuel stains and oil seemed to cover every surface and under her belly drips of oil and fluid pooled onto the stained concrete which had supported the weighty presence of these aircraft every day for a quarter of a century. Up close, the Lightning doesn't look quite so sleek; in fact the most striking impression is one of sheer size and bulk, the cockpit towering high above your head atop a clumsy-looking ladder which is clipped to the fuselage side. It looks big and brutal, but by walking round to the rear of the aircraft, you're left in no doubt that this machine is built for speed. The two soot-covered jet exhausts are huge and cavernous, big enough to climb into, and it's difficult to even imagine the endless torrent of burning kerosene, bursting through the ring of mechanical reheat petals and out into a long sheet of white-hot flame. But you only need to look into the mouths of the monstrous Avons to know that they mean business.

Naturally, getting airborne in a Lightning takes some preparation. Before I had even got anywhere near Binbrook I was required to spend a long day at North Luffenham, a former Canadian Sabre base, where a Royal Air Force aero medical expert delighted in telling me and the assembled class of students about the varied and exotic ways in which we could get ourselves killed. Fast jets are not sports cars and they have to be treated with the greatest of respect, especially when they routinely operate in an environment which is completely hostile to human existence. As if to emphasise this point, our class was treated to a spell inside Luffenham's decompression chamber so that we could experience for ourselves what would happen if the Lightning's pressurisation failed at altitude. Entertaining though it is, the sight of blue fingernails and a paper covered in unintelligible scrawl (which you thought was a

Pictured 'at home' outside No.1 Hangar at Binbrook, XS458 proudly displays a full-sized LTF emblem on her tail, based on Binbrook's station badge. This was subsequently replaced by a smaller (and rather less attractive) marking which the aircraft continued to wear until retirement. (Photo: Dick Lohuis collection)

beautiful drawing at the time) is enough to convince you that hanging around at the Lightning's operational heights without pressurisation would be a very bad idea. When I finally made my way to Binbrook, another of the Lightning's characteristics was quickly impressed upon me – the extremely cramped nature of the cockpit. Before we could make any pre-flight preparations the most important task was to measure my legs to ensure that if I was forced to eject from the aircraft, I wouldn't leave my lower legs behind, trapped under the instrument panel coaming. With the aid of the Medical Officer's ruler and his desk top, we eventually determined that I had a comfortable nine millimetres to spare and so I could fly. Unfortunately for some, being too tall was a guaranteed way to never fly in a Lightning and the height limit was generally only a little over six feet. With the MO's examinations and deliberations complete, the next task was to get myself fitted with the necessary flying clothing – the standard gear applicable to all of the RAF's fast jets, comprising of a thick rubber immersion suit and boots, anti-g trousers (the infamous inflatables which fiercely grip your legs and stomach when g force is applied) and a surprisingly heavy helmet complete with oxygen mask, plus a weighty life jacket to slip on (or more accurately, climb into) later. Needless to say, even though you might feel tempted to act as if you're on the set of Top Gun, the sheer weight and restrictiveness of the gear makes you feel less like Tom Cruise and more like the Michelin Man – a triumph of necessity over glamour. Finally, it's time to get acquainted with my pilot (Flight Lieutenant Mark Ims from No.11 Squadron) and our aircraft, Lightning T.Mk.5 XS458, a long-time Binbrook resident which had served with both No.5 Squadron and No.11 squadron prior to joining the Lightning Training Flight, whose blue lion motif was proudly displayed on the tail fin surfaces. First flown in December 1965 (little more than three years after I was born), XS458 first served with No.226 OCU at Coltishall although as a relatively late arrival, she did not get to wear the flamboyant red, white and dayglow orange markings which adorned the first T.5s assigned to the OCU. Nearly twenty-two years later, XS458 was still very much in business as the LTF approached their last few days of activity prior to disbandment.

While Mark conducted a careful inspection of the aircraft's exterior, I carefully made my way up the aircraft's access ladder and – at what already seemed like an indecently high altitude – gingerly inserted myself into the cockpit, first standing on the seat pan of the right-hand seat before slipping my legs down into the space below the instrument panel. Once onto the seat, a member of the ground crew team followed me up the ladder and assisted me with the business of attaching myself to the aircraft and the ejection seat, routing and attaching the leg restraints (which go through the clip-on garters around one's lower legs) to the base of the seat, then attaching PSP (Personal Survival Pack – the dinghy and associated gear), PEC (Personal Equipment Connecter – which supplies air and oxygen and the pressurised air for the g-suit) and RT lead before routing and securing the seat and parachute harnesses. Helmet and gloves on, oxygen mask attached and by this time Mark was already busy

Glistening under Norfolk sunshine, XS458 is seen at Coltishall in 1973 when the aircraft was part of the resident Operational Conversion Unit (2T Squadron). As a late-delivery T.5, this aircraft did not receive the early eye-catching red and white paint scheme applied to the OCU's T.5s when they first arrived at Coltishall, but the shiny bare metal scheme contrasts vividly with the dull camouflage which was applied to XS458 just a couple of years later. (Photo: Dennis Daws)

During 1975 when consideration was being given to camouflage schemes for the Lightning fleet, XS458 was one of two aircraft which received experimental paint finishes, replacing the unpainted bare metal which had hitherto been common to all UK-based Lightnings. XS452 received a Dark Green paint scheme while XS458 was painted in an overall Dark Grey scheme during September 1975 (the undersides remaining bare metal). Ultimately, a two-tone camouflage was adopted for the fleet and both 'trials' Lightnings were repainted accordingly. (Photo: Paul Tomlin)

climbing into the left-hand seat. By now it was clear that sitting in a Lightning is an intimate affair and underneath the endless straps, cables, rubber suit, helmet and oxygen mask, there was a distinct feeling of claustrophobia which was only increased when the huge and bulky canopy was lowered.

★ ★ ★

The biting cold of the Lincolnshire winds is replaced by warmth and a distinct odour that would be familiar to any fast jet pilot – a sickly but strangely reassuring mix of kerosene, oil, leather and vomit. With everything set to go, Mark signals to the ground crew and starts the first engine, resulting in the familiar hissing spurt of noise from the Avpin unit, and a slight tremor felt through the seat as the mighty Avon rumbles into life at the first attempt. The instruments start to wind up and once Mark is content that the engine is safely stabilised the second engine is successfully started, accompanied by another loud hiss and a growing rumble which is mostly felt rather than heard although even with the protection of a very thick bone dome there's no doubt that the engines are turning. Canopy down and locked, the wheel chocks are pulled away and at last we're free to go flying.

Back from another high-speed run along Cranfield's runway, XS458's external appearance is drastically improved when compared to her final years of RAF service at Binbrook, when 'working' camouflage covered her upper surfaces for over a decade. Under the care of Russell Carpenter, XS458 remains in excellent running condition at Cranfield, more than forty years since she was first manufactured. (Photo: John Davidson)

Although XS458's flying days are over, the aircraft is maintained in excellent condition and a team of dedicated volunteers ensure that the aircraft is able to make occasional high speed ground runs at Cranfield. Engine runs are also frequently made, and the sight (and sound) of the mighty Avons is a popular attraction for the many aircraft enthusiasts who travel to Cranfield to witness the magnificent Lightning come to life. (Photo: John Davidson)

With a gentle hint of power, the brakes are released and we roll forward, performing a jolting curtsey as Mark checks the brakes for effectiveness. Then we turn right and begin to wind our way along the flight line past the assembled line of sister aircraft and out onto the long taxiway towards the northern end of Binbrook's main runway. The ride is comfortable but quite bumpy thanks to the Lightning's narrow wheels which are pressurised to an astonishing 360 psi. Hardly surprising that I can feel every bump and crack in the concrete surface. Once the initial feeling of confinement begins to wear off, the view outside becomes more interesting and although the Lightning's canopy framing is quite heavy, it's easy to see out to my right-hand side as far back as the aircraft's wing leading edge. The view to the left isn't quite so good, and apart from the very close shoulder-to-shoulder proximity of Mark my pilot, there's a lot of instrumentation and flying controls between me and the other side of the canopy frame. The view ahead however is very good, especially when my last flight had been in a tandem-seat Hawk, sat a few feet directly behind the pilot and a blast screen.

By comparison, it felt as if I was sitting on the very nose of the aircraft. Out to my right, I can see the famous crash gate where I'd spent so many hours with my camera, watching the Lightnings trundle by on their way to the runway. The crash gate became what was probably the most popular and well-known aircraft enthusiast meeting point in the whole country where people from all walks of life (some even coming from overseas) would gather to simply stand and look, fascinated and captivated. It was strange to see the crash gate from the opposite side and it wasn't particularly surprising that even on this grey, windy and cold afternoon there was still a visible crowd of onlookers, some giving us a wave as we went by. I waved back of course. Just seconds later and we came to a halt at the holding point just short of the runway while Mark completed his run-through of the last pre-take-off checks and removed the safety pin from the seat pan between his legs while I removed mine and safely stored it. The ejection seats were now live and once we had sufficient forward speed, we could use them if we needed to at any stage, should things go very wrong, very quickly. Helmet visor down, seat straps good and tight, safety pin out, canopy locked, legs as far away from the control column as possible (the last thing I'd want to do is restrict its movement) and I confirm to Mark that I'm good to go as he talks to Binbrook's ATC to seek permission for line-up and take-off. We roll forward and turn left, out over the runway 'piano key' threshold markings and onto the centreline with a blaze of twinkling runway lights to our sides, stretching to the horizon. That's it – we're here and we're going flying!

Mark pushes the throttles slowly forward and there's a roar of muffled jet noise from somewhere behind us, combined with a growing tremor which rattles through the aircraft. The instruments show that the thrust from the two Avons is coming up to eighty per cent of their maximum power and the aircraft's nose nods down towards the concrete as the power pushes against the wheel brakes. But we're not hanging around – off come the wheel brakes and the nose perks back up as Mark brings the engines up to full power and we lurch forward as the roar of the Avon's thrust thunders against the airframe and makes a valiant attempt to push its way through the canopy and my bone dome. We're rolling forward and with another manipulation of the throttles from Mark, the reheat comes in and we suddenly push forward still faster with a surprising but smooth kick, almost like changing gear in a sports car. We're already racing down the runway, weaving very slightly either side of the centreline markings, and the raised barrier at the far end of the runway is already getting alarmingly near, and we seem to be bounding towards it at breathtaking speed – which of course we were by now, and a quick glance at the airspeed indicator tells me that we're already way past 100mph. By the time I look up again, Mark is gently lifting the nose wheel off the runway and almost imperceptibly the aircraft swiftly follows, rising smoothly and effortlessly into the air, and not a moment too soon, as the runway threshold flashes by just fifty feet or so below us. The undercarriage immediately slams up (before the limiting speed of 250 knots is reached) and a couple of muffled bumps

A rare picture of XS458 about to get airborne on a (very) short post-servicing test flight, minus the ventral tank that was inevitably carried by all Lightnings. Although the later F.2A and F.6 variants never flew without their larger tanks fitted, some earlier Lightnings did occasionally make short test or ferry flights in 'clean' configuration. Not surprisingly, such flights rarely lasted for more than around ten minutes! (Photo: Terry Senior)

are confirmed by the 'three greens' popping off on the instrument panel. The Lincolnshire landscape is a few hundred feet below now and it's racing by with such speed that it's difficult to keep an eye on any particular detail close by as it would be gone as soon as you look at it. Far better to look straight ahead through the windscreen into the gathering gloom. Down goes the port wing and up comes the starboard wing as Mark rolls us to the left and hauls the huge brute round towards the east before pulling us up into a gentle climb which pops us straight into the surrounding cloud. Suddenly the feeling of speed is replaced by a weird motionless sensation, suspended in a sea of greyness. The roar of the engines has subsided now (or more precisely we're pushing ahead of it) and inside XS458 there's a more comfortable, cosy feel of a gentle tremble from beneath our seats, combined with a steady rush of airflow hiss, competing with the buzz and murmer of the radio chatter. There's a lot to occupy my attention inside the cockpit, with a bewildering array of instruments and switches right in front of me, some of which I recognise, like the artificial horizon and compass, and of course the strange strip speed indicator which was fitted to later Lightnings. Even stranger is the throttle box which instead of being close to my left hand, is over on my right side against the cockpit wall. I'm no pilot, but the idea of holding the control column with my left hand just seemed bizarre, the more I thought about it.

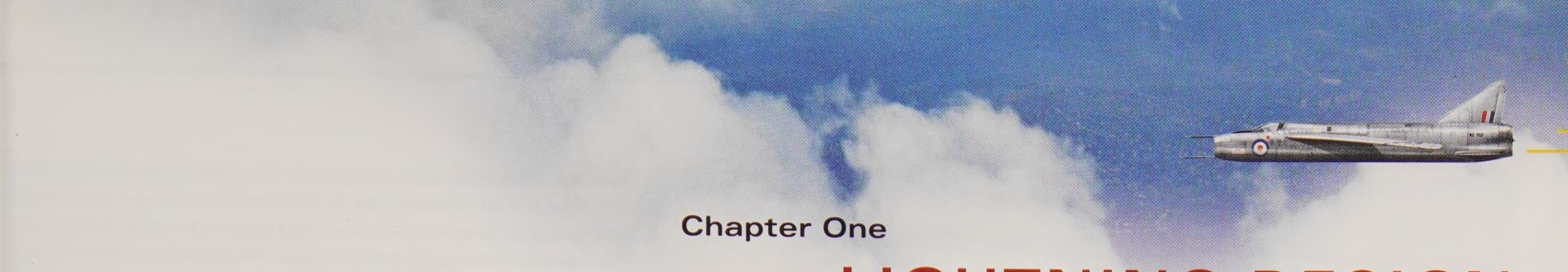
But enough of the inside – we're through the gloomy cloud layer now and out into the sunny skies over the North Sea, the Humber Estuary off to our left somewhere under the carpet of lumpy white-topped cloud below us. We're heading north and slowly creeping up to 18,000 feet for a rendezvous with a refuelling tanker somewhere off Newcastle. The Lightning T.5's lack of fuel capacity would normally mean that by now we'd already have to be thinking about heading back to Binbrook soon, but with tanker aircraft busy refuelling Tornado F.2s ahead of us, there's an opportunity to fill-up without going home. Mark introduces me to the radar display – a small CRT screen buried inside an almost comical rubber 'boot' which enables the viewer to stick his face against it and block out any distracting glare. I peer inside and it's certainly easy to see the screen display but I'm not exactly sure what I'm looking at. Mark tells me that there's a 'blip' on the screen which is our tanker, a few miles ahead of us, but all I can see is patches of radar colour, blobs and specks, and nothing that looks much like an aeroplane. Of course, I've watched too many movies and I'm almost expecting a beautifully clear screen with one aeroplane-shaped dot in the middle but the Lightning's radar is a creature of the 'Sixties (even older in fact) and recognising the radar picture is undoubtedly an art which only the experienced eye can comprehend. I marvel at the very idea of making any sense of the radar picture and mention to Mark that it must be incredibly difficult to peer at his radar screen, fly the aircraft and intercept a target at the same time. He laughs and simply says that it's easy once you've learned how to do it, but I'm not so sure. He's telling me that we're closing-in on the target now and that we should make visual contact very soon so I take that as a good excuse to give up trying to make sense of the radar display and I peer out into the bright blue sky to find our target; and sure enough there it is far in the distance, a tiny grey blur surrounded by even smaller grey speckles. We close in and the shape turns into a Victor from Marham, accompanied by a couple of Tornado F.2s from Coningsby and two Lightnings from Binbrook which were busy topping-up after flying some PIs (practice intercepts) further out to sea. Mark smoothly brings us alongside the port side of the formation so I can take a look at the refuelling procedure as the two Lightnings pull back and begin to descend while the F.2s gently edge back and plug-in to the Victor's trailing hoses, one on each wing. We don't stop too long though and we begin accelerating ahead of the assembled gaggle in search of another tanker a few more miles ahead. Once again Mark quickly brings us into a stern approach (and I'm still clueless as to what the radar screen is telling me) but just a few minutes later we're closing-in behind a VC10 from Brize Norton, all alone and more than happy to fill our fuel tanks. After positioning alongside the VC10, we get clearance to move back to

take our fuel. It all looks remarkably smooth and easy, just gently tucking-in behind the VC10's port wing, slowly edging forward until the tanker's trailing hose basket is literally just a few feet away, twitching and wriggling in the slightly turbulent airflow we've managed to find ourselves in. Mark eases us forward and the basket disappears to my left, behind the thick canopy framing, then reappears over Mark's shoulder, out to my left and I lean forward as best I can against the tight seat harness straps, to see what's going on. There's a recognised technique for plugging into a basket which requires the receiver pilot to look straight ahead at the alignment markings under the tanker, moving forward until the probe makes contact, but Mark's an old hand and he's done this many, many times before. He's looking right at the basket and with some delicate tweaks of the control column he nudges the Lightning up and down, left and right until he puts the Lightning's probe right in the middle of the basket and nudges forward. The probe makes contact with a discernible clunk and we're in, and the fuel starts to flow. It's only then that I look forward and realise just how close we've got to the VC10, the huge swept tail surfaces towering above us. There's a sense of stillness with both aircraft flying in perfect formation and it's difficult to remember that we're all moving along at quite a pace although I can see from Mark's concentration that things aren't quite so calm for him while he's keeping a careful eye on the position of the basket into which we're plugged, and the position of the VC10 just a few feet ahead and above. A few minutes later and we're full, and with a slight touch of deceleration we pull back and the probe pops out from the basket with another clunk, a spray of fuel vapour which briefly spatters across the windscreen, and a wiggle of freedom from the long, bolt-on probe. The VC10 majestically pulls away ahead of us and we slow and turn right before entering a gentle climb. We're heading east, out into the North Sea, and Mark applies power which is barely noticeable until I look at the airspeed indicator and notice that the readout is moving. Mark tells me to ignore the airspeed indicator and concentrate on the Mach meter readout which is more relevant at altitude. It's already moving past 0.8 and up to 0.9 and Mark tells me to keep an eye on it as he selects reheat and as I feel a gentle push of thrust from behind us, the needle moves further along and seems to slow temporarily before creeping forward again across the magic figure – Mach 1.0. We're supersonic.

You'd imagine that there would be some sort of noise or a bump or something fairly dramatic to tell you that you've broken the sound barrier but inside the Lightning there's nothing remarkable at all to see or hear. Things look and sound just the same and the Mach meter just keeps creeping forward ever higher until Mark cancels the reheat and reins-in the Lightning's phenomenal power. Somewhere down below I'm imagining that a lonely fishing trawler will have been treated to an unexpected sonic boom but up here in XS458 it's just another routine part of regular Lightning flying. No magic, no effort. We slow down and turn back towards land and Mark takes the opportunity to show me a little of the Lightning's manoeuvrability, rolling and turning the aircraft, demonstrating that for a very old lady, she's not only fast on her heels, but surprisingly nimble too. Then much to my surprise Mark asks me if I'd like to take the controls and before I'd even stopped to think of what an inexperienced non-pilot civilian is supposed to do with a Mach Two interceptor, he tells me that I have control and I sit there, slightly surprised and unsure what to do next. My first tentative steps to move the control column result in a few banks left and right and after just a few seconds it's easy to appreciate just how responsive the Lightning's controls are. The Hawk that I'd flown for a few minutes a few weeks previously seemed to handle very similarly and yet the Hawk is half the size (and half the age) of the Lightning, but if I'd been flying blindfolded, I doubt if I would have been able to tell the difference. Having promised me that I wouldn't break anything (including ourselves), I followed Mark's instructions and pushed the control column over hard left, which immediately threw us into a rapid and disorientating roll, something which seems alarming at first but instantly becomes addictive, so back we go rolling the other way… and back again. But we can't play forever. Having taken the Lightning into supersonic flight the all-important fuel has started to dwindle again and so we resume radio contact with our VC10 tanker and head back to the long, stately racetrack that the tanker has been holding whilst waiting for customers. Finding the lumbering tanker even with the Lightning's ageing radar equipment isn't difficult for Mark, especially when he also has the luxury of radar/radio vectoring to literally point him at our target and it takes us just a few minutes to race back to the VC10 and slow ourselves down to come alongside and then take-on some more fuel. Once full we say our goodbyes (I give a friendly wave to the faces I can just see behind the tanker's cabin windows), and we turn back eastwards, descending towards an area of growing grey seascape which has emerged amongst the carpet of white cloud.

Down we go, through 15,000 ft, 10,000 ft, 5,000 ft, and I have to make plenty of effort to keep unblocking my ears as the grey sea slowly resolves itself into greens, browns and blues, capped with white fringes of wave crests. We're still descending and the altimeter is showing us down to just 1,000 ft and still slowly going down, until we smoothly level out over the North Sea at 500 ft. Suddenly a small ship of some description sweeps by below us and then with nothing else in sight apart from a greeny-grey horizon, Mark takes us down still lower, right down to 250 ft and then even down some more until the sea looks like it's going to come up and wrap itself around the cockpit. The throttles are going forward too as we hug the wave tops and in comes the reheat again, pushing me firmly back into the ejection seat. The grey wave tops become a blur and we're thundering forward, still accelerating, bumping and banging in the ridiculously rough air down at sea level, salt spray washing up the windscreen and the whole instrument panel shaking and rattling. Mark calls 'pulling up, standby, three, two, one' and suddenly the world seems to turn upside down; I'm squeezed hard down into my seat – so hard that I can hardly keep my head up. It's almost as if someone has dropped an elephant on my head. I can just see out to my right a huge cloud of water vapour billowing around us and XS458's wings are actually moving – they're flapping and flexing and we're going up – straight up, vertically. The g-force stops and as the pressure in my g-suit slowly releases its grip on my body I can turn more comfortably to see the horizon as a crazy ninety degrees, and the seascape rapidly receding far behind us. Another less-brutal application of g-force comes back and the horizon slowly appears ahead of me through the windscreen now, but it's upside down, and with a neat roll the world turns the right way up again and we're straight and level, just a few seconds later, at 25,000 feet. Quite a ride.

The show's over now, and we begin a long, gentle descent back towards Binbrook, back into the waiting cloud cover and then out underneath into the gloom over Lincolnshire, until the welcoming sparkling lights of Binbrook's runway appear ahead of us. We race back at 480 knots, thundering in across the airfield before making another very sprightly turn to port, with another fierce application of g-force which finally stops for good as we level out in the airfield circuit, flying northwards on the downwind leg, airbrakes out and the landing gear rumbling out into the air stream. Everything suddenly seems slow and rather pedestrian now, even though the instruments say that we're still motoring along at over 170 knots and as I spot Grimsby's dock tower through the windscreen we turn left through 180 degrees round onto final approach and settle onto a gentle power-on descent, framed through the windscreen by a blaze of runway approach lights. The instruments read 160 knots now but the sensation of speed starts to reappear as the ground gets closer. Everything looks fine until the very last minute as we streak over the narrow road which crosses the approach path – a place where I'd often stood awe-struck as the Lightnings roared overhead. The seemingly distant runway suddenly rushes up to us at break-neck speed and with a jarring thump Mark slams XS458 back onto the runway, cracking open the brake parachute which quickly starts to slow us down, even though I can't see much evidence of the fact, or feel anything to suggest that we're ever going to slow down. But as the familiar crash barrier starts to look as if it's getting a little too close again, our speed finally settles down to something a little less ballistic and as the Q-Shed comes into view on the left-hand side we're back down to a gentlemanly taxy speed. Off the runway past the Q-Shed, brake chute dumped, safety pins back into the seat and back to the flight line where the canopy can finally be popped open and a welcome rush of cold Lincolnshire air allowed into the cockpit, almost as if to bring me back to reality. We're back, it's over and XS458 is comfortably at rest again, popping and creaking as the engines stop and things start to cool down. Mark climbs out onto the ladder and shouts 'was that okay?' I think it was more than okay.



Chapter One

LIGHTNING DESIGN

THE Lightning has earned a well-deserved place in aviation history as arguably the most advanced all-British jet aircraft design. Yet its origins can be traced way back to World War Two when the jet engine was still in its infancy.

It was during 1943 that the Ministry of Aircraft Production first embarked upon a project to investigate the practical possibilities of supersonic flight. Considering that Sir Frank Whittle's revolutionary jet-powered aircraft (the E23/39 Pioneer) had taken to the skies little more than a year before, it seems quite astonishing that the ministry should have turned its attention to supersonic flight when so much development of early jet engine designs had yet to be undertaken. More than 60 years later it is still difficult to establish what factors influenced its thinking during the dark days of 1943. But it would seem reasonable to assume that the encouraging results of Whittle's early jet engine design work, coupled with information on developments in Nazi Germany, led the ministry to conclude that significant advances in engine and, therefore, aircraft performance would be achieved with relative ease and speed.

This seems to have been a major change of approach compared with earlier official reluctance to pursue the concept of jet propulsion when it first emerged. Indeed, with hindsight it seems amazing that only a couple of years after the Battle of Britain, which had been fought between piston-driven aircraft, serious consideration should have been given to the idea of supersonic flight. But in an era when advances in aerodynamic and propulsion development were (at least by modern standards) surprisingly rapid, perhaps the idea was not quite so wild as it might seem.

In fact, history records that Britain's first tentative steps into the jet age were, to say the least, rather conservative. It could be argued that the Meteor and Vampire were revolutionary aircraft in as much as their power plants utilised the principles of jet propulsion but when Germany was already busy investigating swept wings, tail-less deltas, rockets and axial-flow turbojets, the Royal Air Force was preparing to re-equip with aircraft which were only marginally more capable than the piston-engined designs they were intended to replace. It is all the more remarkable, therefore, that in 1943, long before the first generation of operational jet fighters entered RAF service, the Ministry of Aircraft Production should issue Specification E24/43 calling for an experimental research aircraft capable of exceeding Mach 1.0 and reaching 1,000 mph at 36,000 ft.

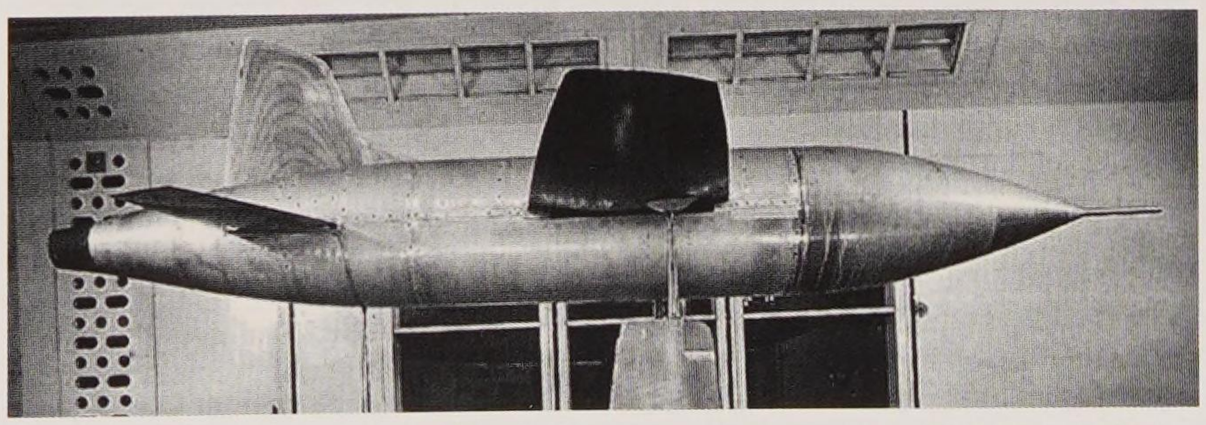
The ambitious and unusual nature of the specification was matched by the rather surprising choice of contractor. Miles Aircraft was a small and relatively unknown manufacturer responsible for a variety of fairly unremarkable light aircraft and trainer designs, although it had flair for radical and innovative thinking. The supersonic project was initiated, quite understandably under conditions of extreme secrecy. Under these circumstances it was fortuitous that Miles had its own metal foundry and was creating its own wind tunnel facilities. This meant that no unwelcome external attention would be drawn to the development of the aircraft, which was eventually referred to by the company and the ministry as the Miles M.52.

The company's reputation for innovative design was graphically illustrated by the emerging outline of the new research aircraft. It featured a narrow bullet-shaped fuselage combined with small bi-convex un-swept wings. The unusual annular air intake surrounded the cockpit section, which was housed inside the intake shock cone. Although the M.52 airframe was unorthodox, the chosen power plant was rather less exotic. Based on one of Frank Whittle's established designs, the Power Jets W.2/700 developed a meagre 2,000 lb of static thrust augmented by a relatively new and unsophisticated reheat system. The very fact that such a relatively low-powered engine had been chosen illustrates the imaginative and ambitious nature of the airframe design. It also highlights the way advances in aerodynamic theory were marching ahead of propulsion technology.

Work on the Miles M.52 progressed slowly but steadily. By the end of the Second World War the project was approaching the end of the design phase with the first jigs being prepared for construction of the prototype aircraft. Both manufacturer and ministry seemed confident that, with further time and development, the M.52 would achieve supersonic flight and could form the basis of further designs which might produce an operational fighter capable of reaching Mach 1.5 and an altitude of 40,000 ft or more. But just as the aircraft began to show promise the project was suddenly cancelled. The official reason given was concern about safety. The Ministry of Aircraft production's Director General of Scientific Research commented that: '*Flying at speeds greater than sound introduces new problems. We do not yet know how serious they are. The impression that supersonic aircraft are just around the corner is quite erroneous but the difficulties will be tackled using rocket-driven models. We have not the heart to ask pilots to fly the high-speed models so we shall make them radio-controlled.*'

Of course, the existence of the Miles M.52 was still secret so it was not until September of 1946 that the absurdity of this statement became clear. The prospect of supersonic flight *was* indeed 'just around the corner,' both in the UK (courtesy of the M.52) and the United States where work on a similar test aircraft was being undertaken by Bell. The precise reason why the M.52 was suddenly abandoned has still not been satisfactorily established even 60 years later. The Attlee government was certainly desperately short of cash (almost to the point of bankruptcy) and this may have been what ultimately led to the project's termination. By that time, however, it had proceeded for some four years and was rapidly reaching the production stage where it would have yielded a return on the Government's investment.

Likewise, the ongoing exchange of technical information between the UK and the USA, especially research data progressively recovered from Germany, may have encouraged some to question the validity of the M.52 design. But when so much work had already been completed and, more significantly, Bell's supersonic X-1 design was remarkably similar in configuration, the argument that there was insufficient confidence in the M.52's design seems difficult to justify. There was also a great deal of commercial resentment against Miles within Britain's aircraft industry and it may have been a combination of these factors which led to the project's cancellation. However, the seemingly indecent haste with which all design and manufacturing work was abruptly stopped was certainly unusual and has led to much speculation over the years about why the aircraft was



One of the Vickers models of the Miles M.52 undergoing supersonic wind tunnel testing at the Royal Aircraft Establishment (RAE) c.1943.

On 14 October 1947 the rocket-powered Bell X-1 flown by 'Chuck' Yeager was the first aircraft in the world to exceed Mach 1. The Bell X-1 was mounted beneath a Boeing B-29 Superfortress and flown up to 23,000 ft where it was dropped clear of the mother craft. Its rocket motors were then ignited propelling it to 43,000 ft and a speed of Mach 1.06 (700 mph). In this photograph 'Chuck' Yeager (on the left) is seen with fellow USAF test pilots Gus Lundqvist and Jim Fitzgerald and the Bell X-1 which was named 'Glamorous Glennis' as a tribute to Yeager's wife. (Author's collection)

abandoned. Some commentators believe that an order was given to destroy all the prototype's construction jigs and that M.52 research data was eventually transferred directly to the US, reportedly in exchange for data which (allegedly) failed to materialise. There is no evidence to support such claims. Even if information was freely exchanged between the UK and US, which was often the case at this stage, there is no reason to assume that the information was of any critical value.

History records that it was Bell's X-1 which earned the distinction of being the first aircraft to break the sound barrier in level flight on 14 October 1947. The X-1 was strikingly similar to the M.52 in terms of external design and commentators have repeatedly suggested that this similarity was no mere coincidence. American accounts of the X-1 project make little reference to the M.52 save for the occasional suggestion that it may have been responsible for the substitution of an all-flying tailplane on the X-1 before its record-breaking flight. There has never been any official American acknowledgement that Britain had any major influence on the X-1 programme and so there is no direct evidence to support the much-discussed theory that it was American interests which ultimately (and secretly) forced the cancellation of the M.52. It is known that American officials *did* have an opportunity to examine the M.52 programme before its cancellation. It is therefore understandable that many commentators should have concluded that the similarity in the two designs and the subsequent cancellation of the British project was not just a simple coincidence. But the precise facts of this murky episode remain frustratingly elusive. Given the time which has passed since the M.52's cancellation it would seem unlikely that the complete story will ever be established and that it will remain the subject of debate by future historians.

The only indisputable fact is that the M.52 *would* have been capable of matching the X-1's performance had development continued. The decision to proceed with trials of a rocket-powered model was largely due to persistence and pressure from Dr. Barnes Wallis (of Dambusters fame) who convinced the Air Ministry that unmanned models would be a much cheaper and safer research tool. It is also worth pointing out that Wallis had made strenuous efforts to ensure that the trials project should be awarded to his company, Vickers, suggesting that his approach might not have been entirely objective. The resulting RAE/Vickers flight test programme was eventually conducted from St Eval, Cornwall, where the 3/10 scale replica test specimens were carried aloft by a Mosquito bomber before launch over the Atlantic test range. The unmanned flight models based on the M.52 design were dogged by technical problems. A huge amount of money, which could have been spent more wisely on completing the full-scale aircraft, was wasted on continual redesign and modification of the rocket motors used to propel the models after air launch. On the second test flight in October 1948 the model's rocket engine did successfully fire and the aircraft raced to Mach 1.38. This tended to confirm the validity of the M.52 project design and the absurdity of abandoning the programme at such a late stage. Perhaps the ultimate irony was the failure of the test specimen to crash-land into the sea after the test flight. Radio links were lost and radar continued to provide plots of the tiny aircraft heading out across the Atlantic, tracing the same path which all of the M.52's research data had reportedly taken many months previously.

Not surprisingly, interest in supersonic design persisted after the success of the X-1 flights. While officially-sanctioned British research was concentrated on the RAE/Vickers programme, some less-official preliminary exploration work was being initiated by British designers, most notably W.E.W. 'Teddy' Petter, the Chief Engineer at the English Electric Company at Preston, Lancashire. English Electric was not an obvious choice for supersonic research. Indeed, it was better known as a tramcar manufacturer and had been largely connected with the relatively uncomplicated licence production of established conventional aircraft designed by other companies.

Petter, however, had an ambitious interest in future design and development and an ability to think in unconventional but practical terms. Responsible for the design of wartime aircraft like the Westland Lysander and Whirlwind, Petter had followed the development of supersonic research with interest and by 1947 had privately started work on his own design studies. Having embarked on the design and development of what was to become the Canberra jet bomber, English Electric was still busy manufacturing the almost obsolescent Vampire fighter for export customers on behalf of de Havilland. Clearly, there was a distinct and almost comical mismatch in the performance of the forthcoming high-altitude and high-speed Canberra bomber and the hopelessly inadequate Vampires emerging almost simultaneously from the same factory. Petter's understandable recognition of this absurd situation was not shared by the government. Despite constant studying of data and even some high-speed experimental flights from the company's base at Warton using a Gloster Meteor F.4, it was some considerable time before the Air Ministry accepted that, with a predicted performance of Mach 0.85 at 50,000 ft, the RAF's new jet bomber would clearly out-perform both the Meteors and Vampires. This might leave the RAF unable to defend UK airspace against any new Soviet bomber which might emerge with a performance similar to the Canberra or better.

It is difficult to establish whether it was Petter who ultimately encouraged renewed official interest in supersonic aircraft or if there was a coincidental meeting of minds. But Petter did finally succeed in obtaining a study contract for a research aircraft capable of Mach 1.5 at 30,000 ft under Specification ER.103. In effect, this specification was little more than a repetition of the now-defunct ER.24/43, which would have led to production of the subsequently abandoned M.52. But with the knowledge that new high-speed jet fighters and bombers were becoming a reality in the US and Soviet Union there was evidently clear determination that the specification would deliver results this time. Both English Electric and Fairey Aviation responded to Specification ER.103. Fairey's programme eventually resulted in the record-breaking FD.2, an aircraft which ably met the requirements of the specification. Although the FD.2 was designed from the outset as a pure research vehicle it went on to influence the design of Concorde and possibly the French Mirage family.

The English Electric proposal was rather different. Petter tasked his deputy F.W. 'Freddie' (later Sir Frederick) Page with the detailed design of their proposal. He was assisted by just one draughtsman. The resulting English Electric concept was undoubtedly more ambitious than the Fairey design. And thanks to Petter's (and presumably Page's) eye for practicality, it had the potential to be developed into something much more than a simple research aircraft. The Air Ministry was impressed by English Electric's proposals and a Draft Specification (F.23/49) was issued on 2 September 1949. This was based on an Air Staff Operational Requirement (OR.268) which had been drawn-up some months earlier.

Although the concept of a supersonic interceptor was still only at an embryonic stage, it is interesting to note just how far-sighted the Operational Requirement was. Entitled 'Fighter with supersonic performance,' it called for a '*...single seat fighter land plane, for day interception duties. Primarily, it*

is required for operating in Europe, but it is desirable that it is capable of operating in any part of the world.'

The OR also specified that the new aircraft's primary role would be the '*destruction of high speed, high altitude bombers in daylight as soon as possible after the bomber is first detected on the early warning system. Great importance, therefore, is attached to quick take-off, the highest possible acceleration and highest possible rate of climb.*'

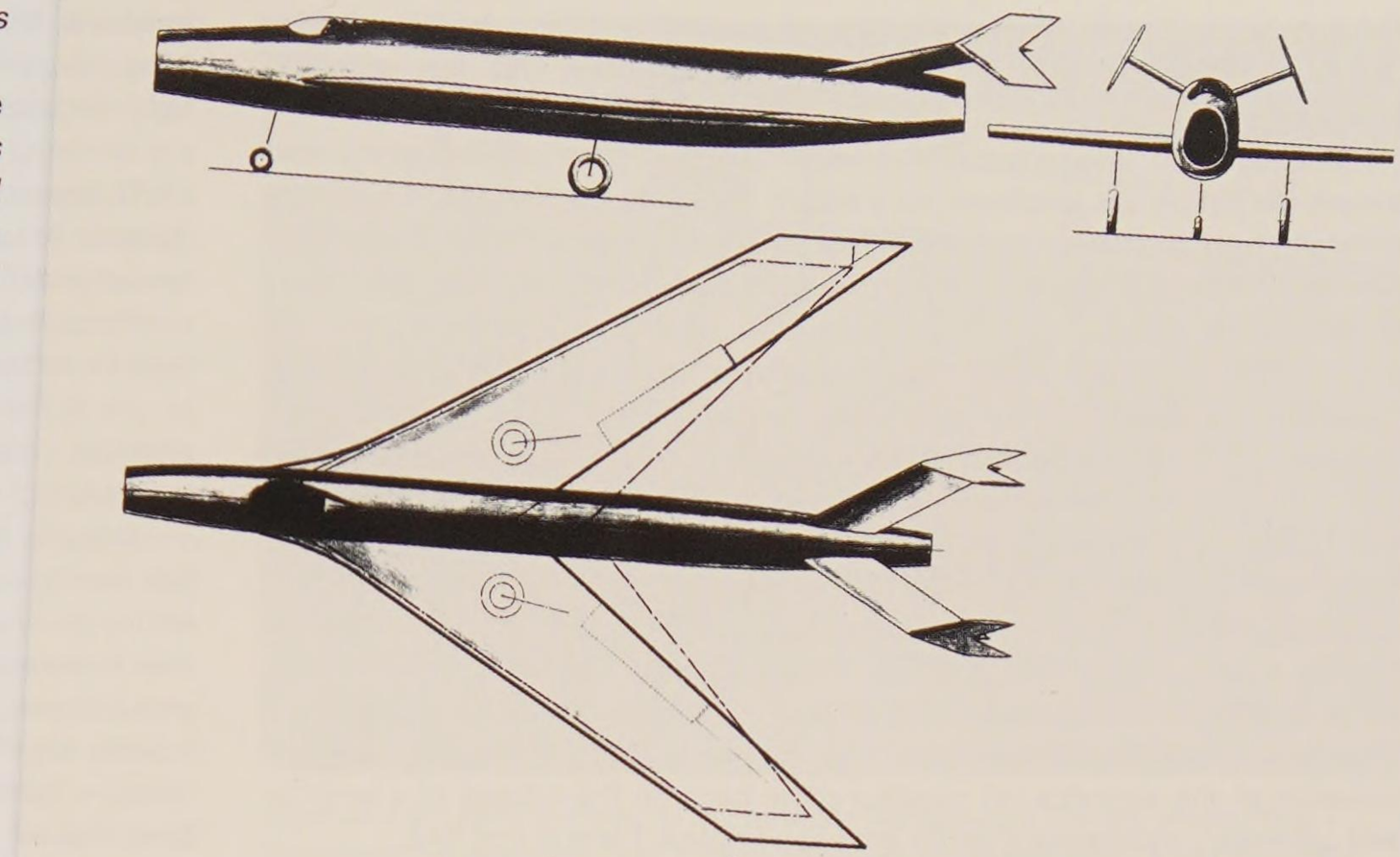
In fact, the OR stated that a maximum speed of Mach 1.2 would be acceptable but that an even higher speed would be desirable if it proved to be technically possible. Although the OR seemed ambitious, it clearly reflected the growing confidence in supersonic research and the design plans outlined by English Electric. The OR effectively established the basic function of what eventually became the Lightning, although in the months and years to come the English Electric design team would be tasked with creating an aircraft which was far more than a pure 'day interceptor.' Having realised that the most serious potential threat to the integrity of UK airspace would come from new high-speed and high-altitude bombers, the Air Ministry was clear that the new aircraft would not be a 'fighter' in the conventional sense.

Although it would obviously be designed to destroy enemy aircraft, it would not (at least in its primary role) be designed to conduct direct air-to-air combat with other fighters. Instead, it would have a more simple but equally demanding role: the destruction of enemy bombers. This would require a rapid engine start and a zoom climb to an altitude of 50,000 ft, all within 6 min. Of course, this emphasis on the interceptor role eventually changed and the aircraft began to be regarded as a more versatile weapons platform. It is, however, interesting to note that despite the seemingly ambitious nature of the OR, it made no significant mention of missile armament at this stage, simply stating that the aircraft should '*carry a minimum of two, with more if possible, of the new high performance 30mm Aden guns.*' Indeed, the only reference to missiles was a vague note that '*the possibility of having rocket or long range armament should be considered.*'

The OR also reflected the Air Ministry's belief that the primary threat would come from high-altitude and high-speed (probably supersonic) bombers operating in daylight, with the assumption that any night or bad weather incursion would probably be lower and slower. With hindsight it seems to be an odd presumption, but most thinking had been based on the experiences of the Second World War and it took a great deal of time to change official thinking. The notion that Britain was still facing the threat of formations of Superfortress-type bombers was flawed. New thinking emerged only slowly and it was eventually accepted that a radar-equipped, nuclear-armed high-speed bomber could attack at any time in any conditions and at any altitude. Unfortunately, this thinking tended to lag behind the design of the interceptor being designed to counter it.

The Ministry of Supply (MoS) awarded a contract to English Electric on 3 August 1948 for a formal design study entitled 'Transonic Research and Fighter Aircraft.' This enabled English Electric to begin the serious business of creating a design which would meet (or exceed) the terms of the OR based on its submission for the earlier ER.103 Specification. But the emphasis was now firmly on operational capability as well as overall performance. Having already made significant progress with the basic design, it took only three months for English Electric to complete and submit its formal proposal which received the company designation P.1. Some commentators assumed this was a reference to the surname of the project's instigator but in reality the 'P' prefix had no specific meaning and, if anything, merely signified 'Project'.

Petter, Page and their design team considered a variety of aerodynamic solutions to the demands imposed by the OR. But the final layout of the proposed aircraft was surprisingly conventional, due in no small part to the company's belief that all designs should be kept as simple as possible to avoid unforeseen developmental problems, costs and delays. This philosophy was already proving successful with the new Canberra bomber and it made perfect sense to apply the same rules to the new supersonic fighter. The basic airframe layout was unremarkable. It comprised a simple tubular fuselage combined with swept-back wings, a choice based on continuing research in the UK and US mostly derived from captured German data. There would have been good reason for adopting a pure delta wing planform as Fairey had done with its FD.2. But Page believed a better solution would be to effectively remove the inboard trailing portion of the delta shape.



Early design drawing produced by English Electric, illustrating the unusual tailplane configuration which was initially proposed, and the two alternative wing sweep angles which were originally considered.

This would offer the most simple and effective means of achieving supersonic flight together with acceptable handling over a wide range of altitudes and speeds.

The choice of power plant was largely dictated by the relatively few options available at that time. Centrifugal-compressor designs were still under development and both the Meteor and Vampire were still taking advantage of gradual improvements to their very basic engine designs. But it was quickly accepted that the P.1 would be powered by axial-flow turbojets, not only because they appeared to offer the greatest scope for further development and corresponding increases in thrust, but also because they enabled the frontal area of the P.1's aerodynamic shape to be kept relatively small. This was a vital consideration for an aircraft expected easily to achieve speeds in excess of Mach 1.0. It was accepted that, although one engine was certainly sufficient to achieve supersonic flight as the FD.2 had shown, the demands of a heavier operational interceptor would require a greater reserve of power. A pair of engines therefore provided the solution, albeit at the expense of additional weight and (potentially) greater drag.

Although twin-engined jet designs were by no means uncommon, the need to achieve supersonic speed demanded a perfectly-contoured aircraft presenting a minimal amount of frontal aerodynamic drag. Incorporating two bulky turbojet engines into the simple design was by no means easy. The chosen configuration represented another testament to English Electric's skill at combining innovation with practicality. The Armstrong Siddeley Sapphire engines would be incorporated within the aircraft's fuselage, but instead of being fixed in a conventional and drag-inducing side-by-side layout they would be stacked vertically. Their combined air supply would be provided via a single central bifurcated intake trunk with one engine staggered rearwards to provide space in the nose section for the pilot and other equipment. This would provide double the amount of thrust available to a single-engined aircraft while creating significantly less drag than a side-by-side or wing-mounted engine placement. Ingenious though this configuration was, it eventually proved to be a source of constant frustration to the thousands of airmen who would later be charged with the onerous task of servicing, maintaining and repairing the interceptor.

Although the fuselage and wing layout was fairly conventional, the tail unit was rather more imaginative. Most contemporary high-speed designs favoured swept tailplane surfaces mounted on top of (or close to the top of) a similarly swept fin. Although this was not an ideal aerodynamic solution, it was generally accepted to be the most practical compromise possible. However, English Electric took the view that its new interceptor would need reliable and effective tail control surfaces particularly at transonic speeds where elevator control inevitably became less effective. Ideally, an all-moving tailplane would be adopted but this would require a fairly thick and drag-inducing fin from which the unit could be fixed and pivoted. Additionally, there was also a distinct possibility that if the pilot had to jettison the cockpit canopy in an emergency, it would strike the tail surfaces.

This could lead to a catastrophic loss of control and, should the pilot be forced to abandon the aircraft, he would probably hit the tailplane after ejecting.

The solution was simply to reverse the accepted configuration and mount the fin on the tailplane. As a result, the early English Electric design emerged from the drawing board with a strikingly unusual layout comprising twin fins fixed to tailplane surfaces mounted high on the rear fuselage sides. It was hardly surprising that this distinctly unconventional aspect of the aircraft's design raised more than a few eyebrows, particularly within the Royal Aircraft Establishment whose highly-specialised aerodynamicists and engineers advised the Air Ministry on aspects of aircraft design. In fact, RAE had a variety of reservations over the proposed configuration of English Electric's design including the more fundamental question of the aircraft's wing sweep angle. The bewildering and often conflicting research data available within the UK and US had encouraged Petter and his team to adopt a wing sweep in the region of 58 to 60 degrees. But more conservative thinking within RAE suggested that 45 degrees might offer a more successful or at least predictable aerodynamic performance. This, combined with the question of the aircraft's tail configuration, became the subject of a lengthy and ultimately expensive dispute between English Electric and RAE.

The first notification of official approval to proceed with the interceptor's design came on 29 March 1949 when the Ministry of Supply instructed English Electric to construct a wind tunnel model. At the same time, a larger test specimen was required for Rolls Royce, currently working on turbojets to power production aircraft, together with another smaller wind tunnel model for high-speed research. English Electric was also instructed to begin provisional design work for the prototype aircraft together with a full-sized mock-up. It was at this stage that RAE intervened with reservations about wing sweep but Petter remained convinced that his team was making the right decisions, commenting in a letter to the Ministry of Supply that '*...we are studying very carefully the question of sweepback, and the pros and cons of 60 degrees compared to 45/50 degrees. I think that there may be good reasons for sticking to the present proposal, subject of course to the wind tunnel tests.*'

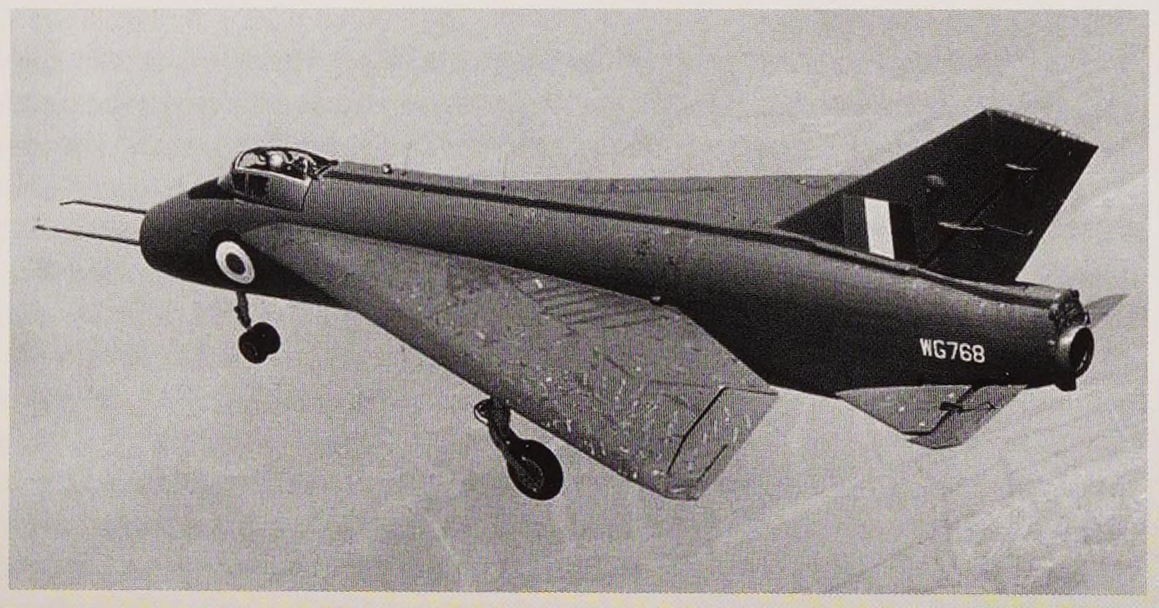
Petter's confidence in his team's design persisted and during October 1949 he wrote to the Principle Director of Scientific Research (Air) at the MoS:

'*It is felt that the stage has now been reached at which it would be possible, usefully, to proceed to an Advisory Design Conference and thereafter to the design and construction of prototype aircraft.*'

Despite Petter's encouraging words he resigned from English Electric just four months later, having decided to take a similar position at Folland. Although there is no reason to suppose that Petter's departure was in any way acrimonious it seems certain that the gradually-decreasing budgets and ever-increasing bureaucracy did little to encourage him to stay at Preston. Indeed, his main motivation for leaving was to concentrate on the design of cheaper light-weight fighter designs which ultimately led to the diminutive Gnat fighter and trainer. His position as chief engineer was taken by his deputy, the former chief stress analyst Freddie Page. Although Petter had been a vital driving force behind the creation of the P.1 design, his departure did not have any major effect on the project's progress, as Page had effectively been handling the design since its inception. By this stage the fundamentals of the aircraft's design were already in place and the various members of the English Electric team were busy handling their own individual aspects of the overall programme.

In April 1950 a contract was finally placed with English Electric for the design and manufacture of two prototype aircraft plus a static mock-up to meet Specification F.23/49 to '*...investigate the practicality of supersonic speed for military aircraft.*' It is interesting to note that even at this stage official emphasis was still being placed on the experimental nature of the project. The MoS had previously decided to refer to the aircraft as an 'experimental fighter' to remove the emphasis from its operational nature even though it '*hoped to evolve something more than a pure research vehicle.*' Indeed, it seems clear that despite the ministry's non-committal attitude, the English Electric team was already determined to produce a practical and capable warplane even if the customer was still unsure as to precisely what it actually wanted or what it could reasonably expect to get.

Official interest manifested itself in the continued input of RAE. It took the view that its scientists could make a significant input into the design process, even though its concerns often seemed to conflict with the English Electric team which was evidently more than capable of completing the design much more rapidly without external interference. RAE's attitude is illustrated by a letter to the MoS early in 1951 in which



WG768 airborne on a test flight with 'tufts' attached to the port wing to investigate airflow patterns. Designed only for low speed research flying, the SB.5's undercarriage was fixed and could not be retracted. (Photo: MoD PE)

Following completion of the P.1 research programme, the SB.5 went to the Royal Aircraft Establishment to continue test flying on various research programmes. After retirement, the aircraft spent many years stored at Finningley, making a public appearance at the station's annual open day, still carrying airflow 'tufts' on her upper wing. (Photo: Paul Tomlin)

an official stated that it would be 'wrong' to regard the English Electric design as '*too much of an operational fighter type.*' The writer added that RAE would '*...have to watch it closely from here, help in its progress and bring to bear on it all the best scientific manpower that we can muster.*'

As wind tunnel tests proceeded RAE continued to express concern at the aircraft's proposed wing sweep and tail configuration. Despite English Electric's confidence that a 60 degree wing sweep would be most suitable, RAE firmly believed that 50 degrees would be advisable. It also believed that a more conventional high-mounted tailplane should be adopted. Although wind tunnel data from both RAE and EE tended to confirm the validity of English Electric's approach, the MoS eventually decided in response to RAE's persistent concerns to produce a purpose-built research aircraft to investigate these matters in flight test conditions and enable a definitive conclusion to be reached. The project was awarded to Short Bros and Harland of Belfast whose SB.5 was created purely for research and not officially linked to the English Electric project. It was in effect a simplified low-speed scale model of the P.1 with the facility for factory-adjustable wing sweep and tailplane to enable a variety of configurations to be flight tested.

The sole SB.5 (WG768) made its first flight on 2 December 1952, complete with the RAE-inspired 50-degree wing sweep and fin-mounted tailplane. Low speed handling trials progressed with the wing sweep eventually changed to 60 degrees and eventually 69 degrees, while the tailplane was re-attached lower on the fuselage. As the SB.5 programme plodded on, English Electric had continued development of its design with the favoured 60 degree wing sweep and low-mounted tailplane – albeit with a more conventional central fin and rudder – located behind wings now positioned slightly higher against the fuselage sides. Ultimately, after testing all of the wing and tailplane configurations under a wide range of conditions, the SB.5 programme simply served to confirm that the English Electric team had been right all along. This was probably just as well. By the time that the SB.5 programme had yielded conclusive results, the 'experimental fighter' had already progressed way beyond the stage where the wing sweep or tailplane configuration could have economically been altered. Consequently, although the SB.5 did produce some useful test data, it was little more than an unnecessary waste of resources whose only significant effect on the P.1's design was the addition of a small notch cut into the leading edge of each wing. This modification was first incorporated on the SB.5 to cure a tendency towards uneven control responses and wing drop at very low speeds. This minor problem had been experienced on SB.5 test flights in the 60-degree/low tailplane configuration. The cause was determined to be irregular break-up of airflow over the wings. The incorporation of small notch devices derived from American research was sufficient to cure the problem. It also provided the design team with suitable locations for the inward vents for the aircraft's wing fuel tanks. Eventually, it was determined that the wing drop had actually been caused by the SB.5's manually-controlled ailerons and the notches were filled in. But they reappeared on the P.1 as a cure for further aerodynamic vortex and boundary layer problems which manifested themselves at transonic speeds. These deficiencies would normally have been resolved by the attachment of wing fences but a suitably positioned notch achieved the same effect much more cleanly. It also enabled the tank vents to be retained in the same positions.

As part of the wing and tailplane design programme, a significant amount of effort was devoted to control surface development. Having established the proportions and position of the tailplane units, the wing-mounted ailerons were – by comparison – designed without any major difficulties. Although straight and swept-wing designs had hitherto relied on aileron surfaces being placed on the trailing edges of the wings, experience with a variety of first-generation swept-wing aircraft had revealed a risk of control difficulties at high angles of attack when the wing surface effectively masked airflow over the aileron. Consequently, English Electric opted to place the ailerons on the trailing wing tips with the main plane trailing edges (swept at 52 degrees) used for the placement of conventional flaps. Some attention had also been given to the concept of fitting leading edge flaps to the inboard section of the wings to improve low-speed handling in take-off and landing configuration. But even though the idea progressed as far as the first prototype, the leading edge flaps were quickly abandoned after it had been established that they were largely ineffective and therefore unnecessary.

Further attention was devoted to the flight control systems. Early experience of transonic flight had revealed a tendency for the controls to lock as speed increased. This was a potentially lethal situation which generally had been overcome either by slowing the aircraft or abandoning it.

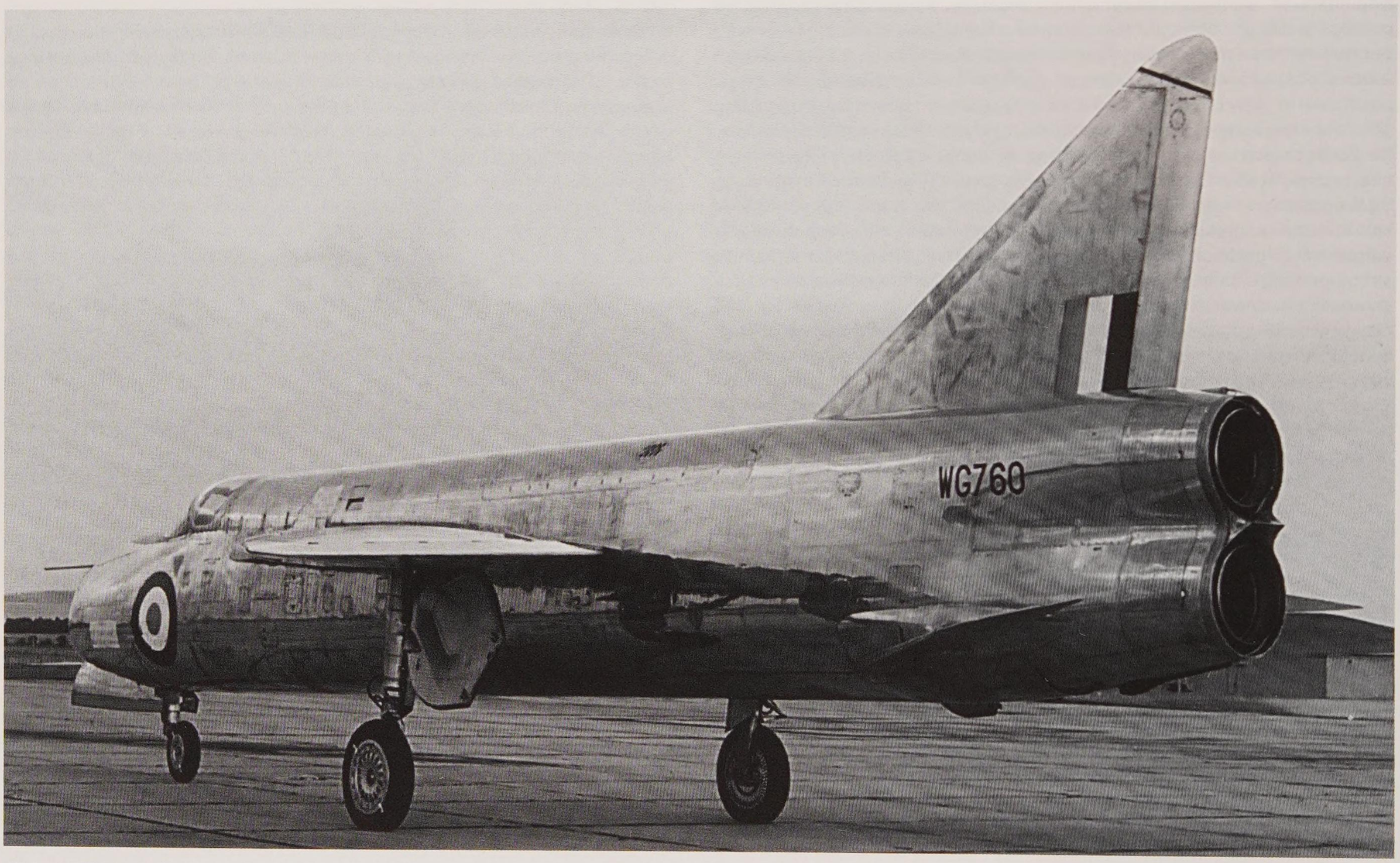
Short SB.5 WG768 is currently on display at the RAF Museum, Cosford, sharing floor space with the previously-fitted T-tail rear fuselage which was flown as part of the RAE-inspired test programme to investigate alternative tailplane configurations for the P.1 programme. (Photo: Paul Tomlin)

It had been established that mechanical assistance was an effective way of overcoming the problem. New designs were already incorporating various means of 'boosting' aerodynamic control surfaces. Even in Britain some progress had been made with the appearance of Hawker's Hunter design which featured suitably-engineered tailplane surfaces. English Electric accepted that a truly supersonic aircraft such as the P.1 would require some very serious engineering to overcome the control lock problem. The flight control surfaces were each fitted with irreversible hydraulic screw-jacks, which ensured that control would remain positive at all speeds. This form of mechanical assistance effectively removed the pilot's direct 'feel' of the controls. A series of springs, cogs and cams artificially replicated the usual feel while also ensuring that the pilot could not over-stress the airframe by demanding control movements beyond the airframe's design limits. This system, fed by a pitot-static intake, enabled mechanical governors and electrical sensors to determine the maximum amount of control movement available at any given air speed. Testing was undertaken in 1948 using a Halifax equipped with a Fairey Hydraulics Servodyne system attached to the aircraft's elevator unit. Although the Halifax was obviously incapable of reaching the altitudes and speeds that any future interceptor might achieve, it did prove the validity and effectiveness of the equipment. Hobson's hydraulic units were ultimately chosen for the P.1.

Aside from the wing and tailplane design, the P.1's nose section was also the subject of great debate. From the outset, English Electric had anticipated the use of a single air intake passing below the cockpit before splitting into two separate sections, one feeding the lower engine while the other routed upwards behind the cockpit to feed the second power plant. This was certainly a good way of achieving a small aerodynamic frontal area. The drawback was the reduction of space for other equipment. Plans were drawn up to locate a single 30mm Aden cannon in the leading edge area of each wing root which was not a structural part of the main wing. But this was not an ideal arrangement since it was thought that a total of four guns rather than two would be preferable and the wing root failed to offer space for the associated ammunition or fire-control radar.

Attention turned to a more conventional nose layout comprising a solid nose and cheek-mounted intakes. This was based on a new design feature being explored by the National Advisory Committee for Aeronautics (the forerunner of NASA) in the US. The experimental work on flush-mounted air intakes looked promising and offered English Electric the possibility of much greater available space in the nose section for a full complement of four Aden cannon with ammunition and associated equipment. It seems clear, however, that even though the idea was pursued with great interest, the English Electric team was less than convinced of the concept's validity. This is illustrated by a 1951 letter to the Ministry of Supply in which English Electric forwarded details of the flush intake/solid nose design but asked that until the configuration had been tested in its wind tunnel the Air Ministry should not be informed about it on the basis that '*... the service would jump at these suggestions, but of course such things as the air intake efficiency remain to be proved and it would be most unwise to over-sell the project at this stage.*'

English Electric Prototype P.1A, WG760, which made its maiden flight in the hands of test-pilot Roland Beamont on 4 August 1954 at Boscombe Down.



P.1A, WG760 pictured at Boscombe Down en route to the runway to make her maiden flight on 4 August 1954. (Photo: British Aerospace)

Frustratingly, much still depended on the precise role which the aircraft would be required to fulfil and even by the middle of 1951 there was still a great deal of uncertainty about this. Clearly, the Aden cannon would be the primary armament but if the aircraft was to be a true fighter as well as an interceptor, then four Aden cannon rather than two would probably be necessary, together with the option of carrying rocket projectiles. This was something that English Electric thought possible through external carriage, there being no internal space available. In effect, official interest in the P.1 was still distinctly lukewarm and, although the design clearly showed great potential, it was still regarded as something of an experiment which might lead to a relatively simple high-speed day interceptor at best.

There was still no major interest in equipping the aircraft with any type of guided missiles at this stage, although it was acknowledged that such weapons were under development and might eventually become relevant to the P.1 design. In fact, there seems to have been no specific time when the emphasis shifted from guns to missiles. But as the project progressed – and the predicted capability of the guided missile became clear – the traditional reliance on cannon armament slowly drifted away in favour of missiles. Rather perversely, there seemed to be little enthusiasm for equipping the aircraft with any guns and this actually materialised with the second-generation Lightning. Of course, the guided missile eventually became fundamentally important to the aircraft's future – in more ways than one.

The uncertainty over the P.1's precise role became the subject of concern when it was realised that prolonged indecisiveness would lead inevitably to delays in completing the aircraft. Although it would certainly be required to

fulfil the interceptor role as outlined in the original specification, it was clear that the aircraft had potential to do much more. But that would require more equipment and further design changes if the aircraft was to become a more flexible machine.

During February 1952 the vice chief of the air staff produced a paper which went some way towards defining the new aircraft's role. Disappointingly, the P.1 was repeatedly compared to the hopelessly outdated de Havilland Venom and VCAS concluded that despite its supersonic interception capability, it would lack the Venom's versatility. This was, of course, true but it would certainly be needed, and soon if Soviet supersonic bombers were (albeit figuratively) on the horizon. This apparently short-sighted view of the P.1's potential is, in some respects, understandable given that it might have been difficult to appreciate the quantum leap in capability the aircraft would provide. But it may also demonstrate the first signs of the slightly blinkered official attitude that dogged the aircraft throughout its service life.

Yet despite the frequently slow deliberations surrounding the P.1's projected operational role, there was much greater official decisiveness in ensuring production did not slip too significantly. During 1951 the Ministry of Supply had suggested that at least three pre-production development aircraft should be ordered so that any design changes could be made quickly should early flight testing of the prototype reveal major flaws. Indeed, it was also suggested that the proposed redesign of the nose section with side-mounted intakes should be test flown on a development aircraft. This would enable the concept to be explored as fully and expeditiously as possible. VCAS' 1952 paper also recommended that three additional development aircraft should be ordered. English Electric was duly informed and that the aircraft would be designed to incorporate the much-discussed side-mounted intakes, but only after full consideration of the latest brochure then under preparation by English Electric. When the brochure was finally issued, in July 1952, the cheek intake design had finally been dropped entirely. The brochure explained:

'The present type of nose intake without centre body was chosen when the design was first undertaken because it was the only type of intake known to operate satisfactorily over the whole speed range. More information is now available on other types of intake. Even so, the simple nose entry is still the one about which most is known and is therefore still the most practicable. The primary objective in modifying the fuselage nose was to make space available for armament and equipment without sacrificing performance unduly. Of course, this space had to be suitable for the equipment to be installed: that is, space for a radar scanner had to be in the nose with an unobstructed view of the forward hemisphere. To achieve this, three different types of intake were considered: chin, side and centre body.

'The detail design of the intake affects both thrust and drag; the optimum intake is the one which gives the maximum value of thrust minus drag. At first sight, the chin, or side intake, placed well aft on the nose fuselage, appears to offer the greatest stowage space. However, detailed investigation shows that to maintain intake efficiency at supersonic speeds, no submerging of the intakes can be tolerated. In fact, either the intakes have to be raised well clear of the surface ahead, or else substantial boundary layer bleeds have to be provided. Thus, an increase in cross-section of the aft fuselage cannot be permitted, the cross-section of the fuselage ahead of the intakes must still be equal to the maximum area less the area of intake, bleeds etc. This removes most of the apparent advantage of the side or chin intakes as regards stowage space.

'A considerable amount of data has been accumulated from the USA and careful analysis of this shows that for the speed range in question, only the centre body intake can compete with the simple nose entry on a thrust minus drag basis without the need for excessive and elaborate transonic wind tunnel testing and special provisions such as boundary layer bleeds. Transonic tunnel facilities in this country are unfortunately very limited. Detailed investigation of the centre body air intake shows that the centre body provides a very suitable space for radar equipment of increased size and that, owing to the associated change in the forebody lines, more space actually becomes available. The forebody shape is also improved, giving reduced drag which offsets the effect of the raised canopy.

'A wind tunnel model of this intake has been constructed and the EE transonic wind tunnel provided with a large pumping plant so that measurements of intake efficiency and drag may be made across the speed of sound. Preliminary results are very encouraging, and we believe that these are the only tests of this type so far attempted in Europe.'

Having abandoned the side-mounted intake configuration, it was agreed that the three additional prototype aircraft would incorporate a circular intake featuring a fixed bullet-shaped centre body which would provide space for the necessary radar equipment. This would also free up space for Aden cannon in the lower fuselage and would enable the nose landing gear leg to be simplified. In the first two prototypes, the leg had to be designed to pivot and lay flat under the lip of the ovoid intake. With a centre body shock cone, the central supporting structure would provide just enough space for the nose gear leg to retract into it. Significantly, it was also decided that all three of the new prototypes would be able to carry de Havilland's new Blue Jay AAM, linked to a Ferranti Airpass (airborne interception radar and pilot attack sight system) in the new nose section. To differentiate between these aircraft, which represented a step between the first prototypes and the eventual production-standard examples, they were designated as P.1Bs with the earlier ones known as P.1As. Page later stated that, unlike P.1A, *'...the P.1B was envisaged from the start as an integrated weapon system.'* This required what was in effect a new airframe, complete with more powerful engines, a new navigation system and instrument display, plus an autopilot and stabiliser system linked to the throttles and compatibility with instrument landing systems.

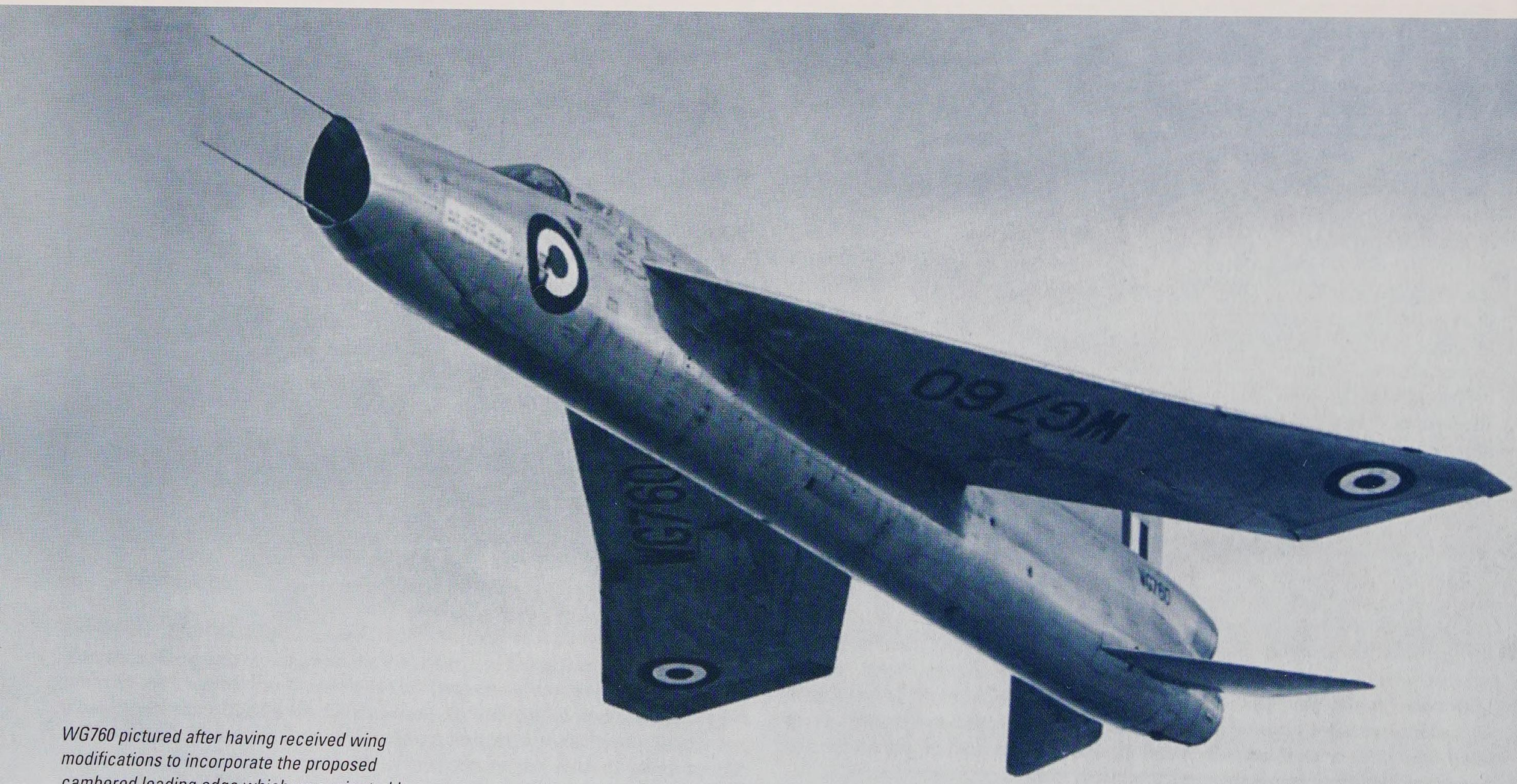
Effectively the P.1B was a completely new aircraft based on the design of the P.1A rather than being merely a development. Most significantly, the P.1B incorporated the newly-developed Ferranti Airpass fit plus the ability to carry two AAMs both slaved to the radar system. This would form the basis of the operational aircraft's weapons system. Although outdated by modern standards, Airpass was remarkably sophisticated when first developed over 50 years ago. It even featured a rudimentary HUD (head-up display) which transferred the radar image on to a reflector screen, enabling the pilot to vector the aircraft to its target without the need to constantly bury his head inside the cockpit. As miniature high intensity CRT's (cathode ray tubes) were not available during the early 1950s the system relied on miniature high-intensity incandescent light bulbs. Although they reduced the effectiveness of the display, it would still have been sufficient to enable pilots to use the radar, weapons system and aircraft in much greater harmony. Unfortunately, the Air Ministry lost interest in the revolutionary HUD facility and turned its attention to an American development using CRTs and eventually abandoned the concept in favour of a more conventional radar screen mounted above the aircraft's main instrument panel. It was just one of many potentially exciting advances which could have been embraced but which were simply abandoned.

The P.1As had been equipped with Armstrong Siddeley Sapphire Sa.5 engines but these power plants were soon regarded as stop-gap units pending the development of Rolls Royce engines which offered the promise of significant increases in thrust. The Sapphire's 8,100 lb of thrust was enough to enable the P.1A programme to proceed without delay. But even with the combined thrust of two engines, the P.1A was unlikely to achieve sustained supersonic flight, not least because the severely limited fuel load of the first P.1A meant the aircraft would probably run dry before acceleration to Mach 1.0 or more was achieved. The second P.1A had the advantage of a rudimentary reheat system. This provided some additional thrust but it became clear that the Sapphire was unlikely to be developed to a stage where any further major improvements would be available. Page turned his attention to Rolls Royce and entered into discussions about the possibility of creating a completely new engine for the P.1 which would be ideally suited to supersonic flight. Rolls Royce was, however, less than enthusiastic at the prospect of embarking on a completely new engine and after further discussions with Bristol – based largely on the concept of using just one Olympus engine – it was accepted that the best compromise would be to opt for a development of the Avon with reheat.

Early EE/RR proposals explored the possibility of a fixed nozzle reheat system which would result in a relatively small, light and uncomplicated unit. However, RAE research suggested that this would reduce the P.1's cruising height by as much as 10,000 ft. It would also reduce endurance by some 15 per cent if reheat were then used to restore the cruising height. This was too high a price to pay. As an alternative, EE proposed a very odd concept comprising a jettisonable baffle which governed the size of the reheat nozzle, maintaining a small diameter for dry thrust until detached, at which stage full reheat could be selected. The idea had some merit because it would have enabled full reheat to be employed without any loss in height or endurance. But the prospect of continually replacing part of the reheat unit after every sortie was not quite so appealing. Both Page and Rolls Royce continued to discuss the possibility of a completely new convergent-divergent reheat nozzle specifically for the P.1B programme.

Eventually, English Electric opted for the RA.24R Avon engine but only after completion of a design study jointly funded by EE and the MoS to

In-flight picture of WG760 illustrating the clean lines of the P.1A. Visible are the wing leading edge drooped flaps which were subsequently abandoned. (Photo: British Aerospace)



WG760 pictured after having received wing modifications to incorporate the proposed cambered leading edge which was rejected by the Air Ministry for many years until finally being adopted for the Lightning Mk.6. (Photo: British Aerospace)

establish that it could successfully be mated with the airframe. The study revealed that the engine would be suitable but only after extensive redesign of the centre and rear fuselage. Even with this redesign, any observer could have been forgiven for thinking that the P.1A fuselage had literally been built around the engines, such was the snugness of the installation. This tight fit was to become a permanent engineering nightmare throughout the aircraft's service life, with many areas of cabling and ducting being accessible only through the complete removal of one engine if not both.

As design work on the P.1Bs progressed construction of the three P.1As was completed at Samlesbury, a second English Electric airfield just outside

It was with some irony that the first P.1A eventually found a home at Binbrook, where the RAF's Lightning force was ultimately concentrated. Having been on open display for many years, the aircraft was refurbished at Binbrook and after a period of storage, it was transported to Cosford for display. (Photo: Terry Senior)

Preston. The main company airfield just down the road at Warton was the obvious choice for the P.1A flight trials. But with an anticipated landing speed in excess of 160 knots, it was accepted that Warton's 1,900 yrd runway was too short to accommodate the aircraft safely. Work began to extend the runway to 2,500 yrd. To expedite progress the first P.1A (WG760) was dismantled after ground tests were completed at Warton and, complete with supporting reassembly jigs and a plethora of support equipment, headed south by road to the Aeroplane and Armament Experimental Establishment (A&AEE) at Boscombe Down in June 1954. After a rapid reassembly, WG760 immediately embarked on a series of engine ground runs and system tests, culminating in the first taxi trials on 24 July.

The tests proceeded smoothly with brakes, steering and brake `chute being fully explored before attention turned to handling, which required a series of high-speed runs along Boscombe Down's huge runway. A 500 ft hop along the runway at 140 knots confirmed that the aircraft was stable in all axes and fit to fly. Even Boscombe Down's 10,000 ft runway would have been inadequate to safely recover the P.1A had the brake parachute not deployed effectively. The first flight was scheduled for 3 August. Preparations proceeded smoothly until English Electric's Chief Test Pilot, Roland Beamont, accidentally made an incorrect switch selection during the pre-start checks. This caused the engine bay fire extinguishers to be discharged and the resulting mess had to be cleared overnight in preparation for another attempt. Shortly before 10:00 hr the following morning WG760 rolled on to Boscombe's runway and, after awaiting the approach of the designated chase aircraft, Canberra WH775, the P.1A finally thundered into the Wiltshire skies. Beamont's written report provides the fascinating details of the first flight as he experienced them from the cockpit:

F.23/49 WG760 Flight No.1

'Weather conditions: dry runway. Light variable wind at 90 degrees to the runway, backing; 6/8 high cloud; small amount scattered low cloud; visibility 4-5 miles in slight haze. Runway 24.

'A full cockpit check was carried out which revealed no defective items except for the leg straps on the Mk 3 ejection seat. The individual leg harnesses had been checked previously but the lacing had not been completed during the previous checks. On coupling the lacing in accordance with the maker's instructions it was found that the lacings were required to interconnect between the left and right leg. With feet on the rudder pedals this resulted immediately in a severe restriction of backward control movement. After re-checking this case it was decided that flight could be accepted without the leg harnesses owing to the existing speed limitation and the circumstances of the flight. Radio checks with the tower and flight test van were satisfactory. Stopwatch failure soon after initial tripping prevented a time record being taken of the flight. Instrumentation was switched on after start-up. Take-off was made with flaps down and without attempting to lift off at the lowest possible speed. After lifting the nose wheel at approximately 120 knots the aircraft became airborne easily with slightly under full elevator at approximately 145 knots. The attitude was checked immediately on becoming airborne with a small amount of forward stick, and as the aircraft gained speed it became progressively nose-up in out-of-trim.

'The undercarriage was selected up at approximately 160 knots and power was reduced to maintain approximately 200 knots in a shallow climb. The undercarriage retracted rapidly with slight asymmetry, which caused a small lateral displacement. This was over-corrected with aileron control, which under these conditions was very sensitive, but the resultant oscillation was damped immediately by centring and momentarily relaxing stick hold. The undercarriage locked home before 200 knots and as speed was gradually increased above this point buffet was noticeable from the flaps.

'As Indicated air speed exceeded 250 knots the flap blow-back valve operated and the flaps returned to neutral with the selector down. This resulted in further nose-up out-of-trim and full nose-down trim on the indicator was not sufficient to return to in-trim flight. Speed was reduced to 200 knots, the flap selector moved to "up" and then at 190 knots selected to "down". Flap operation was normal and it was noted that there was little buffet from flaps below 200 knots. Flaps were retracted at 210 knots. At this speed nose flap only was selected and apart from a very slight nose-down trim change no other effects were noted (lessening of the existing nose-up condition).

'With flaps retracted power was increased and altitude increased to 8,000-9,000 ft. IAS was increased progressively up to 400 knots and at this point there was no buffeting or roughness. The ailerons, which were noticeably sensitive, became progressively more so with increase in IAS with the result that lateral damping seemed to be rather lower than desirable. Releasing the stick in all cases damped out the lateral oscillation immediately, however, and it was thought that much of this over-sensitivity in lateral control resulted from the fact that the pilot had at all times to hold a small but noticeable nose-up out-of-trim force. Height was increased to 13,000-14,000 ft and speed increased to 400 knots IAS/Mach 0.75. Under these conditions the lateral control remained very sensitive but adequate. During a course alteration to avoid a cloud layer, the nose was depressed slightly and speed inadvertently increased at idling power to approximately 440-450 knots. This was reduced as soon as level flight could be resumed. Dive brakes were checked at 300-400 knots at 13,000 ft over approximately 2 to 4 degrees of movement. In each case, after the initial slight nose-up trim change, very heavy buffet began. This was associated with an erratic directional characteristic, which immediately resulted in an erratic rolling displacement due to yaw. These circumstances were not regarded as satisfactory and the tests were discontinued subject to further progressive investigation at low speeds.

'During the climb it had not been easy to control the air conditioning with the cold air unit, as with this there was a tendency either to be too hot or too cold. The cabin air ram valve was opened and found to produce a pleasantly distributed flow of cooling air. This was kept open at all times during the flight except for a short period at 14,000 ft where it was closed to test pressurisation, which was found to be satisfactory at this height. During the descent the inner surface of the centre armoured glass panel became misted

with the NESA switched at "half". Switching the NESA system to "full" cleared this condition in a few minutes. During descent with power reduced to idling, considerable difficulty was experienced in obtaining a reasonable rate of descent while keeping IAS below 400 knots. This may tend to be a minor limiting factor in the flight test operation if the present dive brakes prove to be unsatisfactory.

'With the fuel state at 1,000 lb it was decided to return to base and during this some difficulty was experienced at a critical point in obtaining homing facilities from Boscombe. Once the circuit had been regained, circuit manoeuvrability at 350-250 knots proved excellent with vision forward and sideways rather better than on the Hunter. Turns at and up to 2.5g were comfortably executed with nose flap up and with nose flap down turns up to 2g at 250-300 knots again were positively stable. In a proving flight of this description a detailed appraisal of feel is not possible, but the increase in Q-feel forces on the tailplane control with increase in airspeed seemed to be precisely suitable. The undercarriage was selected down at 230 knots and locked rapidly with green indicator lights at 210 knots. There was asymmetry in this operation, which resulted in the expected lateral displacement and correspondingly momentary over-correction with aileron. This case is similar to that experienced on the Hunter. Flaps were lowered at 200 knots and in doing so returned the aircraft to in-trim longitudinally, still with full nose-down trim.

'A final turn was carried out at 200-190 knots and speed reduced to 160 knots at short finals and the throttles returned to idling. A normal hold-off was made crossing the boundary and a final check comfortably and easily executed at 150 knots. The touchdown was smooth at a reasonable attitude with excellent vision of the runway at approximately 140 knots. The parachute was streamed at approximately 135 knots and this operated with a delay of the order of 2 sec. There was an immediate nose-up pitch and weathercock yaw to starboard requiring approximately full port rudder to hold. This condition was easily controlled and once the nose wheel had returned to the runway, light wheel brake was applied to bring the aircraft to a standstill. The parachute jettisoning operation was satisfactory. At standstill the port wheel thermocouples indicated 160 degrees C. During the flight a pitot position-error check was carried out with the pacing Canberra WH775 and this gave 195 knots at 8,000 ft.

Summary

'From this short flight the following main points were clear:

1. *The main services functioned satisfactorily with the exception of the dive brake, which gave heavy buffet, even at the small angles employed.*
2. *The trim actuators were satisfactory on rudder and aileron but that on the tailplane control provided inadequate nose-down trim.*
3. *Longitudinal and directional static stability was positive in all flight conditions experienced so far. The aircraft was neutrally stable laterally with adequate damping, stick free.*
4. *Tailplane feel and response was entirely satisfactory under all conditions and there was no sign of over-sensitivity leading to pilot-induced oscillation.*
   Aileron response and spring feel was very sensitive and powerful and required a light touch to prevent fairly continuous over-correction. It was not easy to apply this light touch owing to the necessity of holding nose-up out-of-trim force throughout the whole flight with engines above half power. This condition may be less noticeable when the longitudinal trim range has been adjusted accordingly.
5. *The power control circuits were remarkably free from noticeable friction or backlash.*
6. *The engines were used as required and no detailed attention was paid to engine conditions beyond observing the limitations. They responded normally and entirely satisfactorily to all requirements.*

'In this short flight the aircraft proved to be pleasant and straightforward to fly with the take-off and landing operations lacking in complication. The over-sensitivity in lateral control will require careful observation during subsequent tests.'

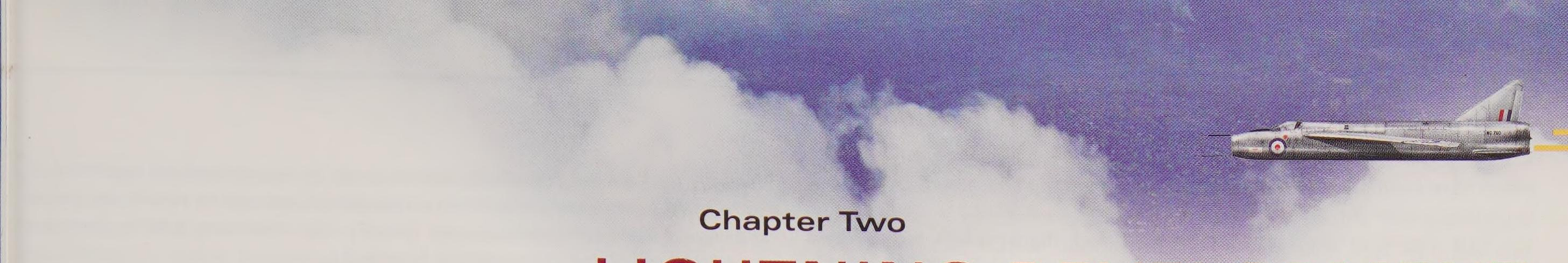
The P.1A's first flight had been a great success. With no significant faults to report, WG760 was towed back into the flight test hangar for an overnight inspection and declared ready to fly again the next day. This time, Beamont took the aircraft up to an altitude of 30,000 ft where he recorded a speed of Mach 0.98. The English Electric flight test team was encouraged to learn that at this speed and altitude the aircraft had performed well with no handling or stability problems being evident. Following the second flight the aircraft's instrumentation was fully corrected and it was discovered that the aircraft's true speed had actually been Mach 1.0 – the speed of sound.

Although Beamont was not aware of it at the time, just a few more seconds of full power would have pushed WG760 comfortably and cleanly through the sonic shock wave and his instruments would have 'jumped' over to the magic figure. Some non-critical problems required rectification by this stage, but the flight test team was keen to forge ahead. Accordingly, the third flight was scheduled for 11 August. In warm summer sunshine, Beamont immediately took the aircraft to 40,000 ft and headed east over Swanage before commencing a full-power high-speed run along the Solent towards Selsey Bill.

As on the previous flight, the instruments recorded a speed of Mach 0.98 and appeared to stick on this figure. With the aircraft handling well in all axes, Beamont noted that just four minutes had passed since his departure from Boscombe Down. Now the P.1A was at 40,000 ft on the edge of supersonic flight. Still accelerating, and without any noticeable changes in handling or even any vibration, the needle on the Mach meter suddenly jumped and settled on a new figure: Mach 1.01. Almost effortlessly, WG760 had gone supersonic. Acceleration continued and briefly reached Mach 1.08 but with the fuel load beginning to dwindle, Beamont brought the aircraft round through a 30 degree bank over West Sussex.

As the speed dropped back through Mach 1.0 there was a slight tremor and nose-up trim change as the aerodynamic shock wave once again moved ahead of the aircraft. Once within view of Boscombe Down, Beamont entered a shallow dive at 36,000 ft, allowing the aircraft briefly to accelerate back to Mach 1.01. In doing so he produced a loud – and very gratifying – sonic boom over the airfield for the benefit of the assembled test flight team.

WG760 now resides within the Royal Air Force Museum's collection at Cosford, and is maintained in good condition. This photograph illustrates the contours of the P.1A's intake, with the slightly peaked upper surface providing space for a gun sighting radar underneath, while the bulged lower surface of the intake's interior is also just visible, into which the nose gear retracted after twisting sideways. (Photo: Paul Tomlin)



Chapter Two

LIGHTNING DEVELOPMENT

THIRTEEN P.1A test flights were conducted during August, totalling some 11 hours of flying time. No major difficulties were encountered and the aircraft routinely reached an IAS of 450 knots. Although this was 50 knots higher than the provisional limiting speed that had been imposed on the aircraft, Beamont had found it surprisingly difficult to keep to this figure.

Exceeding the speed of sound became almost routine. On one flight the P.1A reached Mach 1.12 and maintained supersonic speed for a total of 3.5 minutes on another. With the runway extension work at Warton now completed, the initial test flying at Boscombe Down was finished. The P.1A was recovered back to Lancashire on 23 September during its 23rd test flight. The stay at Boscombe Down had enabled the fundamentals of the P.1A's handling qualities to be established. A variety of tests had involved crosswind landings and wet runway utilisation and had even included an air-to-air photography rendezvous which served to illustrate the precision of the aircraft's power control system. Some slight aileron over-sensitivity had become apparent as had some seemingly random variations in directional and lateral trim. Beamont eventually established that these conditions were related to changes in throttle settings. When the throttle was moved forward – and the control column untouched – the stick would move back slightly, moving forward again when the throttles were pulled back. The cause was found to be a simple out-of-static balance due to the low friction properties of the high-precision power control circuit. Such problems were relatively minor and were corrected as part of the P.1A's main test programme. Conducted from Warton, this totalled some 703 flights. Beamont's concluding report on the Boscombe Down test phase reveals that, although the aircraft performed well, the most pressing concern was its woefully short endurance. Combined with its high speed, this made each test flight a continual compromise between speed, fuel consumption and distance from the operating base. Beamont reported:

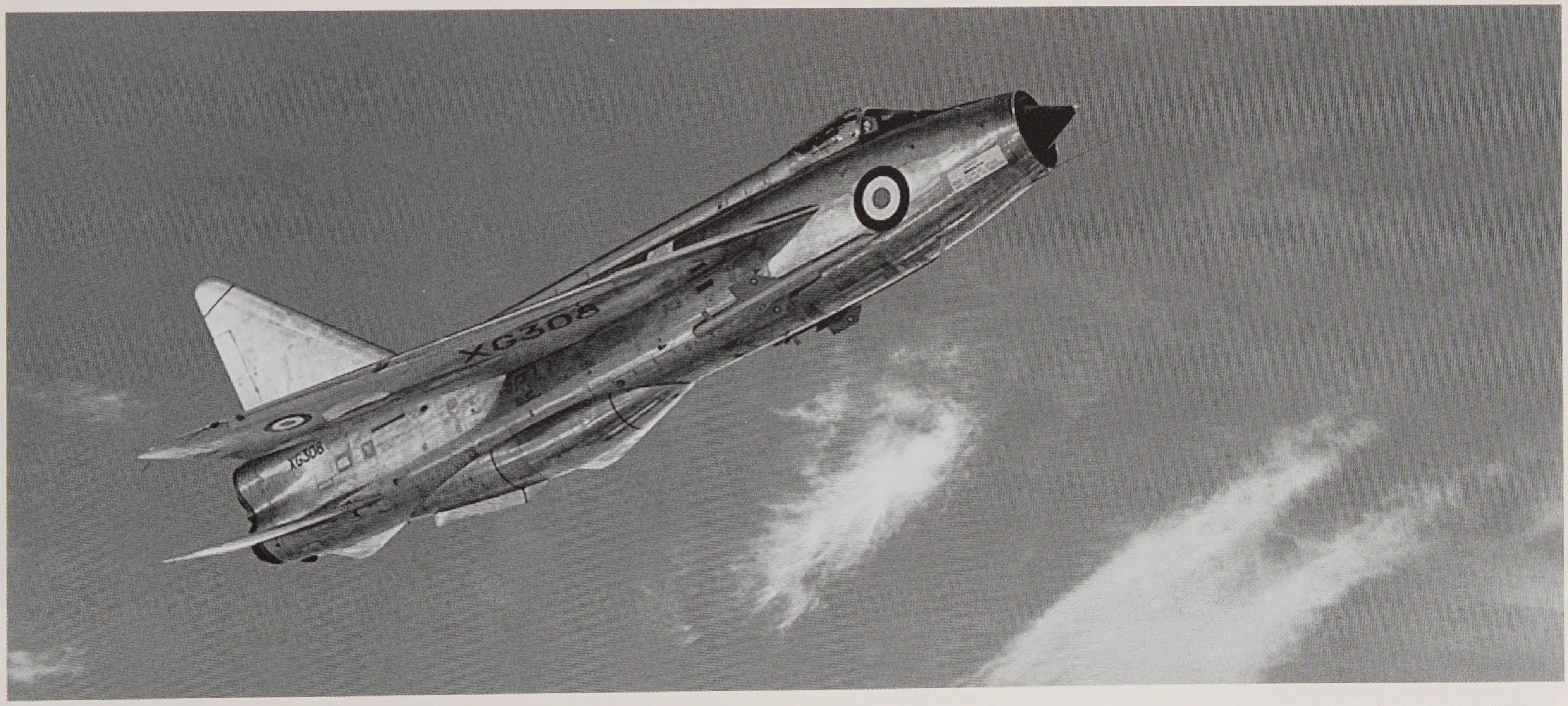
Summary of flying qualities of WG760 upon completion of the Boscombe Down stage of flight testing, October 19, 1954.

Low Speed

'Control response, feel and stability have all proved satisfactory to speeds as low as 120 knots IAS. Approach and touchdown has been limited to speeds in excess of 130 knots by longitudinal trim limitation and the approach, hold-off and landing has proved simple and straightforward. 190-200 knots IAS has proved to be the most comfortable speed for normal circuit manoeuvres but the ability to decelerate quickly on the final approach enables the pilot to carry out the final turn at as high a speed as 200 knots and yet still arrive at the hold-off point without difficulty at 150-140 knots.

High Speed

'At speeds in excess of 200 knots IAS aileron over-sensitivity was experienced initially but this has been reduced by modifications to the aileron gearing. Lateral control is now satisfactory up to 400 knots IAS and 0.85 IMN (indicated Mach number). At indicated speeds above 400 knots this over-sensitivity is still present and will require attention. Longitudinal control feel and response is excellent throughout the speed range from 120 knots IAS to 1.1 IMN. At the highest value of IAS so far achieved there has been no tendency to over-sensitivity with this control. Some lack of positivity continues to be experienced with the rudder control, and trim variations



XG308 was a Development Batch P.1, which (technically-speaking) was neither a Lightning nor a P.1B (no official designation having ever been given to these aircraft). The aircraft was regularly assigned to A Squadron of the A&AEE, undertaking a variety of handling (particularly stalling and spinning) trials. (Photo: MoD)

which have been noted with variation in power setting and speed, are difficult to correct precisely.

'This condition does not adversely affect flight safety but it does adversely affect the general feel and fine control of the aircraft and for this reason requires attention. Longitudinal stability has proved positive up to high subsonic speed and beyond Mach 1.0. There is some suggestion of a slight reduction in transonic stability. During the considerable amount of transonic manoeuvring that has been carried out during the first 23 flights, this reduction in stability has not been in any way marked and in fact requires further instrumented testing to confirm its significance. Transonic and supersonic flight manoeuvrability in the longitudinal and lateral sense is excellent, but directional control lacks the positivity that is desirable. The aircraft remains directionally stable to the highest speeds reached to date but although there is no sign of directional oscillation at any time in the present flight envelope, there is some loss of directional damping in manoeuvre above Mach 1. It may well be that this condition will be improved when the present suspected deterioration of the rudder control is corrected.

Endurance

'In the uneconomical handling-flight circumstances of the first 23 flights, the fuel capacity has provided an average flight endurance of approximately 35 min with fuel left after landing averaging approximately 50 gal per engine. The latter amount is barely sufficient for one safe overshoot, circuit and landing, and it can be seen therefore that this aircraft must be operated with much lower fuel margins than has been the practice during Canberra development, when the average fuel margin during the first two years of operation was never less than 250 gal after landing. This narrow margin places emphasis on the need for precise navigation and good flying conditions and, although all flying to date has been carried out under good conditions at base, this difficulty has already been experienced and valuable testing time wasted in obtaining VHF bearings during high speed flight over cloud.

'Relatively large distances are covered during performance testing at altitude, for example, 50 miles in 5 min and if, as frequently occurs, 2 min or more are required to establish a VHF fix, it can be seen that the pilot has no alternative but to spend a high proportion of the short flying time in using this means of confirming his position in relation to a safe return to base. This short series of flights has confirmed the absolute necessity for a constant bearing type of aid such as a radio compass or DME/Rebecca if maximum practical value is to be obtained in flight testing or subsequent operations. Under economical cruise conditions it is apparent that flight endurance of 50-55 min will be obtainable with the same safety margin as that described above.

Cockpit

'With some modifications to particular instruments and systems the cockpit layout has proved satisfactory but the control column trim neutral is uncomfortably far forward and this will require the maximum possible adjustment aft. Some difficulties have been experienced with overloading of the instruments and services power supply, but these have largely been overcome. When functioning correctly, the electric and hot air demisting systems have not failed to demist the canopy and windscreen areas under conditions of rapid descent from altitude, but no test has yet been possible of descent from an extended cruise into conditions of very high humidity. Control of cockpit temperature has proved to be difficult with the existing system, the pilot being either too hot or too cold alternately. Familiarity with the system enables a measure of phase advance to be memorised but this is not completely adequate and it is probable that, owing to the lag in warming up to full heat, flying under winter conditions will prove to be extremely cold because of the short period between take off and reaching operating altitude, namely 5.5 min from brakes-off to 40,000 ft (and less with reheat). Some loss of maximum heat was noticed during flights 21, 22 and 23. The modified Martin Baker seat has increased comfort and is satisfactory. Recent flying experience in late evening light has indicated the necessity for the fitting of cockpit lighting before the short days of November, December and January. Without cockpit lighting flying during these months would need to be limited to no take off after 15:00 hr.

Landing distance

'On the smooth surface of the Boscombe Down main runway, landing distances without brake parachute have averaged approximately 1,800 yrd. Use of brake parachute reduces the possible landing run average by about 500 yrd but self-jettisoning failures of the slip unit have been experienced recently and the tail parachute system must for the present be regarded as unreliable. In the most unfavourable case tested, namely no parachute, slight crosswind, light rain and very wet runway, the minimum landing distance was 2,400 yrd (2,600 yrd corrected for wind).'

By the end of 1954 WG760 had flown a further 27 times since returning from Boscombe Down and testing was completed to a standard deemed suitable for the first 'preview' trial by service personnel. Beamont's summary of the completed initial flight development illustrates how the aircraft's performance envelope was being gradually expanded:

Low Speed

'Static stability and control response have been checked in level flight to 125 knots IAS and in shallow descent to 112 knots IAS. There was no noticeable deterioration in stability and all three controls remained adequately positive.

High Speed

'Further development of the aileron power control system has led to the introduction of non-linear gearing. This, by increasing control column movement relative to aileron deflection over a limited range about neutral while leaving the gearing unaltered over larger deflections, has resulted in the elimination up to the existing IAS limit of 480 knots of the over-sensitivity in roll encountered and criticised previously. This change has resulted in an aileron control with excellent qualities of response and damping with a high degree of smoothness and lack of noticeable break-out forces or lumpiness at neutral. There is a small but noticeable increase in the amount of control column movement required to produce required aileron deflections in the approach configuration, but this increase is not in any way embarrassing. Resonance tests and subsequent flutter calculations have permitted an increase in Mach number limitation to M 1.2 and during flight investigation this speed has been achieved and exceeded slightly (1.22 IMN/455 knots IAS in a shallow dive). This condition was entirely smooth without buffet or deterioration in control or stability from the previous highest speed achieved of 1.15 IMN.

'Recovery with tailplane control was smooth and trouble free. Up to flight 50 supersonic speed has been achieved 40 times and during these tests some experience has been gained of supersonic manoeuvrability in the operational sense. Curves of pursuit were carried out in excess of Mach 1.0 at other aircraft, and on one occasion five air-to-air PE checks were carried out at transonic speed with a Canberra from Warton cruising at Mach 0.8. In none of these circumstances was any difficulty experienced in completing the curve of pursuit under conditions steady enough for gun aiming. In the case of the highest speed conditions, during which Mach 1.05(T) was maintained during the major part of a shallow dive curve of pursuit to pass within 200 yrd of the target, there would have been no difficulty in making fixed armament attack. During some of those runs, evidence was felt of the shock wave by the pilot of the target aircraft as a mild bump. Further flight testing and investigation of the rudder circuit revealed that the latter was out of dynamic balance in such a way that changes in longitudinal acceleration could affect directional trim. Mass balance was added to the rudder circuit and flight tests showed an immediate improvement in the directional trim variations which had been troublesome before. The elimination of this trim variation provided a small but marked improvement in general fine control of the aircraft (the elevator/tailplane circuit was subsequently modified also, with similar results).

Endurance

'The longest flight to date has been 49 min with a fuel margin of 600 lb on touchdown. Further flying in Lancashire winter weather conditions has continued to emphasise the need for improved navigational facilities. It has been found that refuelling is sensitive to some extent to aircraft ground attitude, and on a number of occasions when the aircraft has been filled in one position, by the time it has been re-positioned near the runway for take off, the indicated fuel reading has been as much as 400 lb low. Fuel checks, and if necessary further topping-up when the aircraft is positioned adjacent to the runway, have eliminated this.

Landing

'Initially at Warton, accelerated tyre wear was experienced under heavy braking conditions and this was eventually proved to be associated with the high coefficient-of-friction surface which was put down on Warton's runways to ensure good all-weather braking facilities during Canberra development.

Two 300-yrd strips of smoother Macadam surface have since been put down, one at each end of the runway beginning at 100 yrd from the ends. In all subsequent flying it has been found reasonably simple to judge the touchdown to within plus/minus 100 yrd of the centre of the new strip and accelerated tyre wear on "spin up" has been virtually eliminated. In addition, in order to reduce the accelerated wear brought about by heavy wheel braking on the remainder of the rough runway surface, the landings have been carried out at Warton with tail parachute and with use of wheel brakes restricted to light brake for steering and for the final slow down. This has ensured a reasonable tyre life of at least 15 landings per main wheel tyre. During one of the early landings the tail parachute jettison mechanism self-released and an un-premeditated emergency stop was made with wheel brake only. The aircraft was halted in 1,800 yrd from the beginning of the runway. In all subsequent operations the Vickers slip jettison mechanism has been positively locked and the landing made with the parachute streamed. After using the minimum amount of wheel brake necessary to turn off on to the perimeter track at 1,900 yrd the aircraft has been stopped and the tail parachute disconnected. The tail parachute jettison mechanism has been designed and will be proved during forthcoming tests at Boscombe.

Cockpit

'The control column trim neutral, previously criticised as being uncomfortably far forward, has been modified and the in-flight neutral brought back approximately 1.5 in. This has resulted in a considerable improvement in comfort and ease of control. The windscreen demisting systems have been tested under conditions of rapid descent after extended cruise at altitude and all the areas served by the Triplex, NESA or hot air demisting have remained mist-free under severe misting conditions. The starboard quarter panel, which is not at present supplied by any of these services and has only a dry air sandwich, has misted severely on the inner surface, the interlayer and, after landing, on the outer surface on two occasions. On subsequent aircraft this quarter panel will be supplied with hot air and Triplex demisting. During the Boscombe tests it was necessary to de-rate the cold air unit blower as a result of two failures of this equipment, and this resulted in a noticeable loss of cabin conditioning hot air. This system has since been modified and the hot air now available is more than adequate for all conditions experienced to date. Preliminary red cockpit lighting has been fitted and cleared on the ground but not yet in flight.

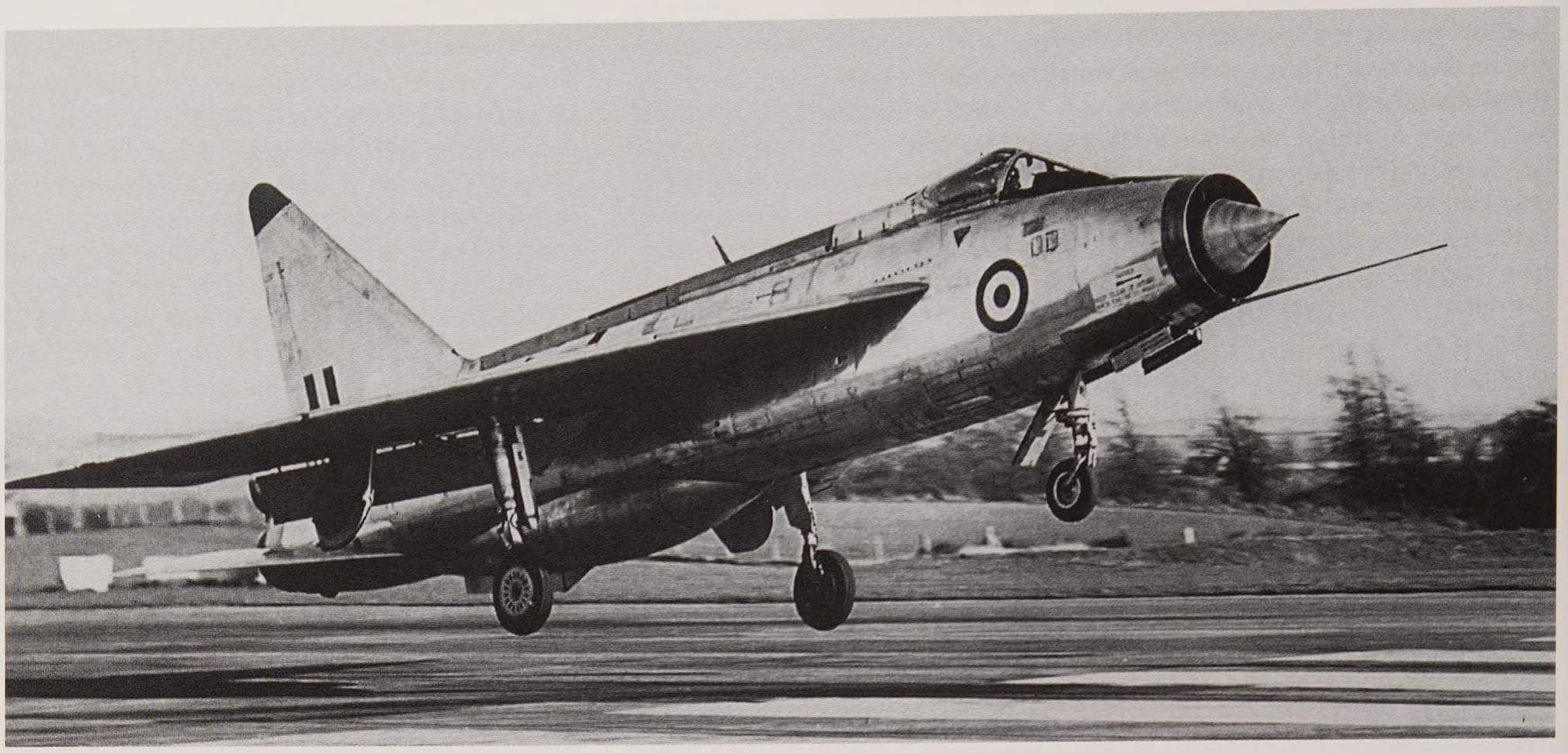
Summary

'In its present condition the P.1 prototype WG760 has straightforward characteristics of take-off, climb and landing and any pilot who has had experience of the Sabre/Hunter class of aircraft will experience no difficulty in flying it. Even in its present under-powered condition, the performance far exceeds the imposed limitations and great care must be taken by pilots to observe these. Supersonic level flight may be achieved between 35,000 and 42,000 ft but this requires 3-4 min of stable full power conditions which is extravagant in fuel, and pilots may prefer to accelerate beyond Mach 1.0 in shallow dives to increase their useable testing time per sortie. Transition from subsonic to supersonic flight occurs in the 1g case with very mild buffet and a small nose-down trim change between 0.91 and 0.94 IMN. Under normal acceleration conditions (ie under g) when increasing speed in this range of IMN, a short nose-up trim change occurs which although not a true '"pitch up" nevertheless disturbs accurate flying in this narrow speed range.

'Flight in excess of Mach 1.0 is smooth without buffet; the aircraft is stable longitudinally and directionally and all three controls are smooth, precise and powerful. There is some reduction in directional and longitudinal damping beyond Mach 1.0 but this condition does not appear to deteriorate with increase in speed up to the maximum tested of Mach 1.24 and is only noticeable to the pilot as a need to pay more attention to co-ordinating the controls in manoeuvre. At present, with only approximately 49 per cent of maximum design thrust at Mach 1.0, altitude performance is poor and, although 47,000 ft has been reached on test, there is little value in exceeding 43,000 ft as above this altitude the margin between the minimum drag speed and maximum performance becomes very small. In the landing configuration the high induced drag is noticeable under conditions of normal acceleration at low speed and a relatively high proportion of maximum available power is required to maintain height in the turn on to final approach. For the same reason speed and height may both be lost rapidly on the final approach if reasonably close attention is not given to maintaining the correct amount of power.

In conclusion, it is now considered that the aircraft is in a suitable condition for familiarisation by other company pilots and it will be prepared to go to Boscombe Down for this purpose in the near future. Whilst at Boscombe it will be possible for a limited number of A&AEE pilots to obtain flight experience on the aircraft in order to give the service the opportunity of commenting on the opinions expressed to date by the company concerning

The second P.1A WG763, pictured outside the Flight Test sheds at Warton. (Photo: British Aerospace)



XA856 was transferred to Rolls Royce, assigned to Avon development trials at Hucknall. Pictured with a Stage 2 fin (retrofitted prior to delivery to RR), the aircraft is about to touch down on Hucknall's relatively short (by Lightning standards!) runway. (Photo: Rolls Royce)

the general flying characteristics of the aircraft. In this connection it must be borne in mind that the P.1A prototype is not fully representative of the operational aircraft of which the third prototype, the P.1B, will be the first example.'

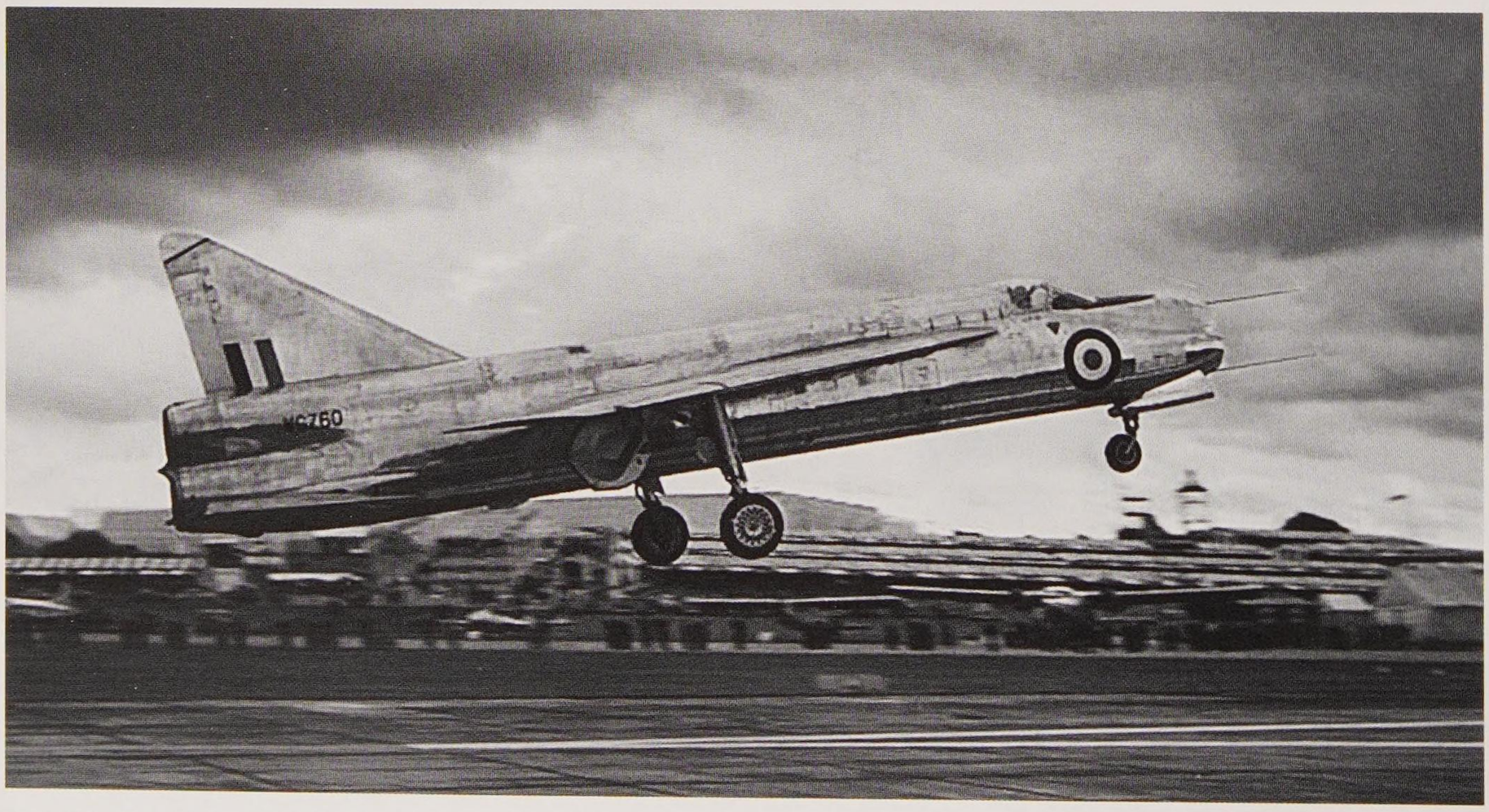
WG760 clearly performed well and in some respects had exceeded the manufacturer's expectations. Beamont was certainly impressed with the aircraft and his enthusiasm caused some eyebrows to be raised both figuratively and literally on 15 September when a VIP visit to Boscombe Down led by Prince Bernhardt of the Netherlands prompted him to make a spirited low flypast over the airfield which resulted in an official written reprimand. In fact, the flamboyant flypast was not quite as risky as it looked because of the airfield layout: Boscombe's runway significantly lower than the adjacent apron. But when a request was made for a similar flypast for VIP visitors back at Warton, Beamont (not surprisingly) declined.

Perhaps the most ironic aspect of this exploit was that the VIP visit to Boscombe had been hosted by Duncan Sandys, a man who was to become associated with the Lightning programme for all the wrong reasons. After returning to Warton, WG760 embarked on a long test programme which saw it regularly exceed Mach 1.0, usually in the designated supersonic corridor over the Irish Sea where sonic booms were unlikely to cause disturbance. But even the Irish Sea was barely large enough. Despite two specific supersonic routes being established for the test programme during 1958, some west coast towns occasionally suffered from sonic boom disturbance, particularly if entry to or exit from these runs was slightly miscalculated.

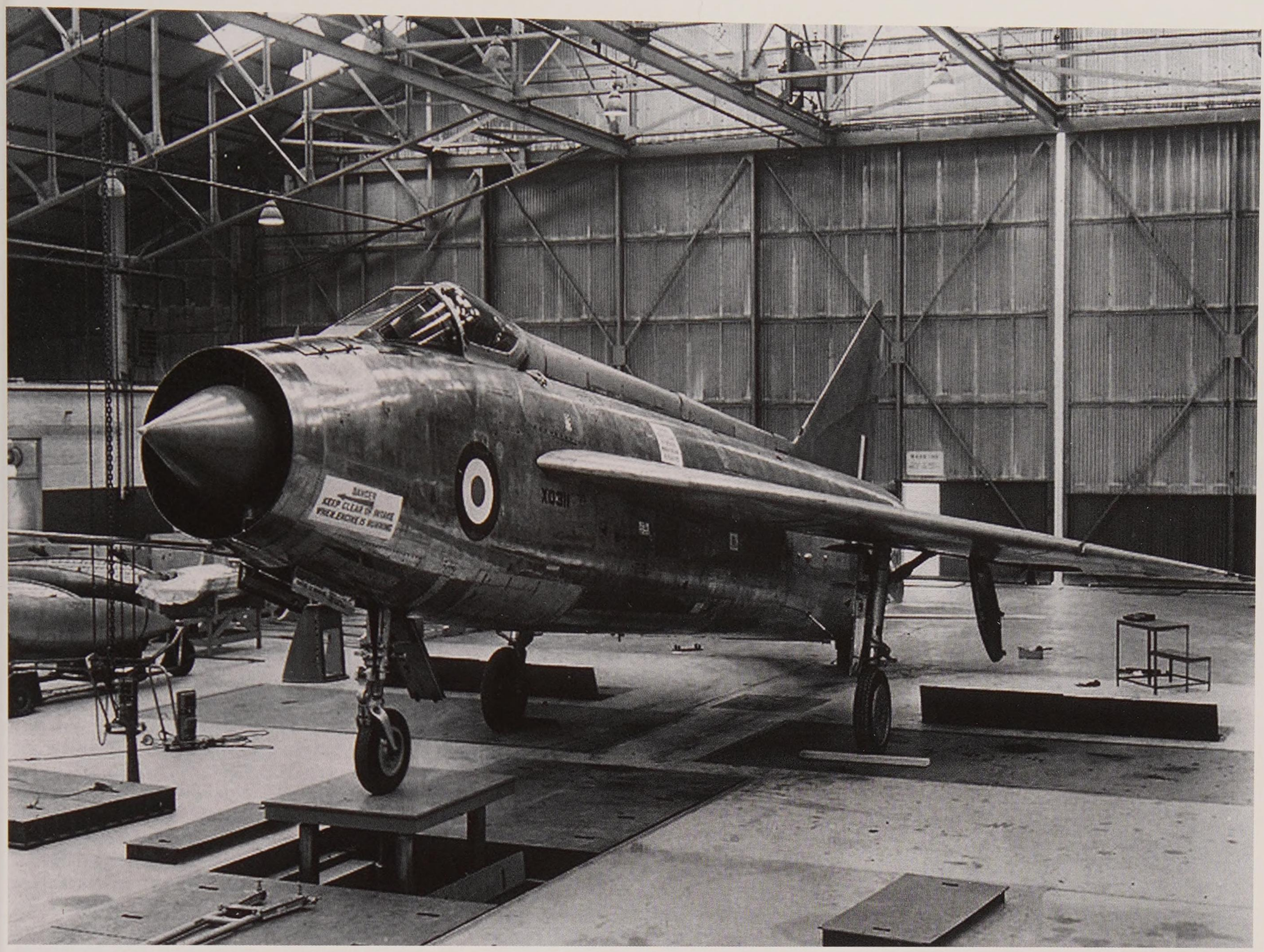
Because of the programme's growing intensity as well as the aircraft's perilously short endurance, some overland supersonic flight was inevitable and sonic booms became a regular occurrence around north-west England. During 1956 particularly loud bangs were heard on consecutive days in Fleetwood and Lytham, causing both alarm and damage, mostly broken windows. Similar bangs affected Southport and Liverpool the following year. This resulted in numerous complaints which had to be handled as tactfully as possible by English Electric and the RAF. But the Warton test programme proceeded smoothly, pausing only for a brief period when the aircraft returned to Boscombe Down to enable A&AEE pilots to fly it and exchange views on handling and performance. Beamont's report provides the details of the visit:

'The period between the 30 hr inspection lay-up in December-January and the Boscombe preview in mid-March was occupied mainly with settling-down checks, especially with regard to engine behaviour at altitude and performance measurements. In the continuously unfavourable weather conditions prevailing, experience was gained of operation in crosswinds and on partly iced runway surfaces. Crosswind components of up to 20 knots were contained without difficulty, and when on one occasion a non-standard tail parachute of American manufacture failed to develop while landing on a runway half covered with sanded packed snow, the Maxaret braked distance to stop was 2,000 yrd from the runway threshold.

'Performance tests to the limit of endurance over overcast once more emphasised the critical nature of this kind of operation when performed without adequate navigational aids. For example, the establishing of three 4-min stabilised performance points on one heading from the top of the climb can take the aircraft more than 150 miles from base before a turn can be made. If visual contact can be maintained no problem exists. But if not, as is usually the case in winter, test conditions do not permit the breaks in concentration of up to 3 min at a time necessary to obtain known positions by radar or VHF fixing so that navigation must be by deduced reckoning assisted by VHF DF bearings. If these are instantly available, and if the aircraft is positioned for an idling descent to base at the end of the tests, then fuel remaining at this point need be no more than 1,500 lb, which will permit a priority controlled descent, a visual half circuit, and landing with 800 lb of fuel. This amount permits one overshoot from the final approach, priority circuit and landing with no further reserve.



P.1A, WG70 thundering in on a stormy day at Farnborough. (Photo: British Aerospace)



Although most of the Development Batch P.1s were eventually refitted with larger Stage Two tail fins, XG311 was never modified, probably because its test career was cut short after being abandoned during a sortie from Warton on 31 July 1963. The undercarriage failed to lower (a problem which afflicted a considerable number of Lightnings) and test pilot Don Knight ejected from the aircraft, which subsequently crashed in the Ribble Estuary. (Photo: British Aerospace)

'It can clearly be seen, therefore, that if for reasons of weather or lack of radio priority, it is not possible to carry out a flight plan to the above pattern, then corresponding increases must be made in the fuel reserve at the point of break-off of tests (or operations). In the first 100 flights the average fuel remaining on landing has been about enough for 10 min. This reserve, which not long ago would have been described and treated by Air Traffic Control as an emergency case, is in fact quite adequate provided that the above limitations are observed. But improved navigational facilities are clearly essential for extension of this operation from the present relatively fair-weather role. The paramount need for constant presentation in the cockpit either of known position or of distance and bearing from a known position; and either of the equipments providing the latter facility should now be urged with the highest priority for introduction into this class of aircraft from prototypes onward.

Development at Boscombe Down

'At Boscombe Down 16 flights were made by four pilots new to the aircraft. These pilots reported the unanimous opinion that the aircraft was pleasant and straightforward to fly and exceptionally so at supersonic speeds. They confirmed the criticisms which had been expressed by the company and were not able to discover any further defects. While at Boscombe Down the Maxaret wheel brakes were fitted with modified response valves. This modification resulted in elimination of judder on a number of landing runs when using minimum torque. During subsequent flights an occasional instance of very mild judder was reported at low taxying speeds but was not always repeatable. No tests were carried out on wet runways. During these tests on at least two occasions the aircraft was stopped with tail parachute and maximum brake torque in less than 700 yrd from the runway threshold (dry surface, wind 15-20 knots on the runway). The filling-in of the leading edge notches, also at Boscombe, resulted in a number of slight changes to the handling qualities and these are summarised as follows:

Advantages

1 *Elimination of all vibration in buffet in 1g transition through Mach 1.0*
2 *Coupled with (1) elimination of premature mild buffet threshold (eg buffet threshold delayed from 1.8g/Mach 0.95/35,000 ft to 2.25g/Mach 0.95/35,000 ft).*
3 *Reduction in aileron over-sensitivity in the range previously criticised, namely 0.9-0.98 IMN.*
4 *Possible reduction in wave drag/induced drag.*

Disadvantages

1 *Forward movement of stick trimmed-neutral approximately 1 inch.*
2 *Deterioration in low speed handling qualities, more especially in clean configuration, by introduction of a mild form of SB.5-type spontaneous yawing instability associated with mild wing dropping over the speed range 175-155 knots. Slight reduction in aileron effectiveness noticeable in association with above condition, and at take off and under all circuit conditions.*
3 *Possible slight pitch-up at coefficient values near the stall at Mach numbers less than 0.8.*

'If the advantages to be gained from this configuration prove to be worthwhile, it will be possible to retain them without the low speed disadvantages by introduction of retractable notches.'

In fact, the notches were ultimately retained on subsequent airframes, albeit in modified form. Beamont continued:

General handling

'The flutter clearance limits remain low at Mach 1.2, 480 knots IAS with a special limit between 20,000 ft and 10,000 ft of 400 knots IAS. The suspected fin flutter case had been encountered at Mach 0.94 and, although not always repeatable, has been encountered again on a number of occasions within the height brackets of 20,000-15,000 ft as a progressive vibration controllable with reduction of speed before becoming unstable. Active measures are in hand to raise these limits. Meanwhile some embarrassment is experienced in attempting to remain within them owing to the high potential performance characteristics and the current lack of dive brakes. Peak speeds achieved so far have been 530 knots below 10,000 ft and Mach 1.28 above 30,000 ft, both cases being smooth and trouble-free with excellent control characteristics. During performance testing an extended cruise was carried out at 0.88 IMN covering 450 miles and arriving overhead base at 12,000 ft with 10 min fuel remaining. Take-off to touchdown was 1 hr 3 min. Delivery flights from Warton to Boscombe and return were carried out in 18.5 and 17.5 min respectively from take-off to overhead. These flights were carried out at 0.98 IMN mostly, with periods of up to 3 min at a time at 1.01 IMN. The improvement in damping and general controllability above 0.98 IMN were on both occasions very noticeable. Conditions for continuous flight at Mach 1.00 may be described as similar to, and in some respects better than, those for a Vampire at 0.7. Navigation on these point-to-point flights was predetermined and corrected by VHF bearings.

'The aircraft has proved capable of all normal aerobatics and is in fact particularly pleasant and precise in the rolling plane. In the looping plane, care is necessary in the present relatively underpowered configuration to prevent excessive drop-off in speed with induced drag near the top of the loop. By applying up to 5g in the first quarter of a looping manoeuvre beginning at 450 knots, the top can be reached easily at 250 knots at rather less than 2g. Very high rates of roll may be achieved in the present configuration and although the existing limitation of no more than 360 degrees in any one roll prevents a dangerous condition being encountered, there is little doubt that if an attempt is made to maintain a roll through 360 degrees at full aileron deflection the beginnings of instability resulting from inertia coupling may be experienced. Throughout this series the tail parachute has continued to give good service and since the introduction of the modified jettison unit operations have been 100 per cent effective with the standard parachute in the last 35 landings. This control is proving very popular with pilots as, in conjunction with powerful and judder-free Maxaret brakes, it gives the pilot confidence in his ability to stop the aircraft easily within the 2,000 yrd of the standard runway. The tail parachute also renders the aircraft relatively insensitive to the variations in runway friction coefficient due to rain, snow and ice. With the fitting of 20 per cent reheat at present in hand, control and stability will be investigated up to design limiting Mach number above 30,000 ft.'

The second P.1A (WG763) made its first flight on 18 July 1955 at Warton. Although externally similar to the first aircraft, the second P.1A incorporated some noticeable changes. The most obvious difference was the addition of an external fuel tank designed to conform to the aircraft's lower fuselage. This gave the impression that it was part of the fuselage structure. In fact, it was detachable, as were all external tanks subsequently fitted to Lightnings. The almost desperate need for additional fuel had been recognised at an early stage of the development process. With an external tank containing 250 gal of fuel, WG763 was a much more flexible aircraft in terms of attainable range and endurance.

It was also fitted with conventional hinged wing flaps. Unlike the split flaps fitted to the previous aircraft, they were also to become standard on later production aircraft, eventually accommodating additional fuel cells. Two Aden 30mm cannon were installed in the nose section ahead of the cockpit. At the other end of the fuselage, the Sapphire engines were standard un-reheated units, contrasting with the afterburner modifications which were being made concurrently to WG760. The wing's leading edge nose flaps were deleted. Internally, the rudder pedals were modified to incorporate toe brakes in preference to the control column-mounted ones in WG760.

With the first P.1A assigned to aerodynamic testing, the second was mostly allocated to development of operational equipment such as the cabin heating control system and the 30mm cannon. Supersonic cannon firing tests were eventually performed. Because so much equipment had to be fitted, modified or ground-tested, WG763 spent little time in the air. During one period with RAE in November 1957, it only flew twice and one of the flights was a post-modification air test. Activity eventually slowed even further when small cracks were discovered in the wing structure the following year and, although a simple repair scheme was devised, months were to pass before the repairs were undertaken.

These periods of inactivity, which included an engine change, led to more serviceability problems. By the middle of 1960 RAE concluded that the time and expense of bringing WG763 back to fully-functioning status was too great and the aircraft was put up for disposal. However, WG763's less than smooth trials programme did include one significant highlight: the first public appearance of the P.1A, at the 1955 SBAC Show at Farnborough. English Electric was understandably keen to show off its creation and requested that the P.1's security status be downgraded to enable one aircraft to be on static display. The Ministry of Supply supported the idea, possibly because of the aircraft's export potential. The VCAS, R. Ivelaw-Chapman, did not, however. He was firmly of the opinion that displaying the P.1A on the ground would be a security risk and that it would enable intelligence agents to photograph the aircraft in detail and thereby calculate its potential performance. To support his view he cited the MiG-15 which British Intelligence had carefully examined in the same way, reaching surprisingly accurate estimates of the aircraft's capabilities.

As a compromise, VCAS agreed that the P.1A could be demonstrated in the air but that it would have to operate from a secure airfield away from Farnborough. The need to balance the advantages of publicity with security was a difficult task. Showing British taxpayers the results of their expenditure was certainly a major political consideration, as was the obvious need to demonstrate to potential export customers what English Electric was developing. Likewise, the existence of a very capable supersonic jet interceptor would send a clear signal to the Soviet Union that the RAF would soon be equipped with another tool in its armoury of deterrence, although publicising an embryonic programme many years ahead of operational deployment would be counter-productive. WG763 did, however, make its public debut at the 1955 show. Operating from Boscombe Down, it duly impressed visitors to the show. As a small concession towards security, the P.1As and all subsequent pre-production aircraft had national insignia and serials applied in varying sizes so that photographic interpreters would be unable to calculate the aircrafts' size. Whether or not any useful information was ever gleaned by the Soviets remains unclear.

Neither P.1A appeared at the 1956 SBAC Show because both were heavily committed to the test programme. WG760 was fitted with reheat in the form of a fixed nozzle system which proved to be another technical headache for both engine and aircraft manufacturer. This required significant and time-consuming testing before it was declared airworthy. While the system was being developed, the P.1A was assigned to other aspects of the aerodynamics programme, including minimum speed landings and assessing performance without the wing-mounted nose flaps. When the reheat system was finally fitted and flown on WG760, Beamont reported that it performed well, although the additional thrust and engine modifications created new problems to be addressed during the test flights.

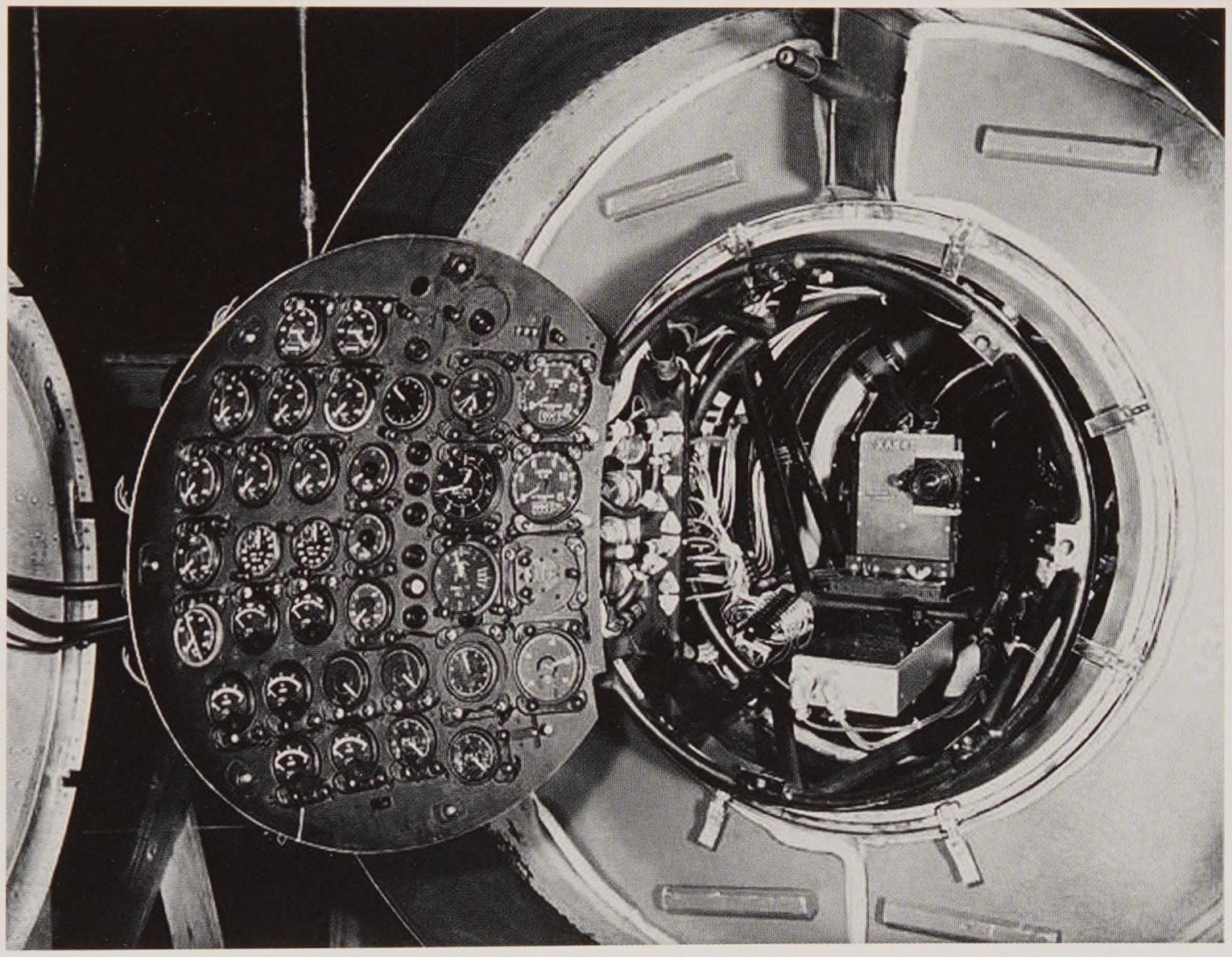
With the new reheat system, WG760 lacked sufficient thrust for a safe take-off on dry power alone. As a result, every take-off relied on successful engagement of reheat. Dry thrust was only marginally sufficient for low-speed handling in the airfield circuit. The additional thrust came at the expense of fuel consumption. This was particularly frustrating when the second P.1A had the advantage of an external fuel tank. But the disadvantages of the fixed nozzle system were understood and simply overlooked to concentrate on the exploration of the aircraft's handling characteristics in advance of the P.1B which would have more representative reheated engines. Speeds of up to Mach 1.4 in level flight were easily achieved and sustained flight at such speeds was maintained for up to 5 min at a time with no adverse handling characteristics being encountered. The aircraft's phenomenal performance enabled Beamont to report that the altimeter rotated so rapidly after take-off that it was easy to develop a phase-lag of around 10,000 ft in reading it and that the vertical speed indicator was simply 'off the scale' for most of the time. Clearly, the P.1's instruments needed to be improved to match its performance. Other test pilots had now

XA847 was the first of three P.1B aircraft, and became the first British aircraft to achieve Mach 2.0 on 25 November 1957. It was later fitted with a hybrid tail fin which featured an extended fillet ahead of the leading edge, as part of development work which ultimately led to the Stage Two and Stage Three fins fitted to production aircraft. (Photo: British Aerospace)

started to join the programme. One, Desmond de Villiers, had the misfortune to encounter one of WG760's less-desirable characteristics: the sudden jettisoning of its cockpit canopy. This happened on three occasions, once with Beamont and twice with de Villiers. It resulted from an inadequate locking system which was eventually re-engineered and strengthened. On one occasion the canopy was found (still intact) by a member of the public in Southport and although unfit for further flight operations, was subsequently refitted to WG760.

Testing of the fixed nozzle reheat system complete, the aircraft was temporarily grounded for further modifications, this time centred on the aircraft's wings. With the leading edge nose flaps now finally abandoned, the featureless leading edge could be redesigned to provide better stability and drag reduction as well as a corresponding improvement in endurance. English Electric produced a new cambered leading edge, together with slightly reduced-span trailing-edge ailerons. The leading edge was now 'cranked' chord-wise on the outboard surfaces, eventually tapering to a squared-off wing tip which would then hold the potential of becoming a mounting point for missiles at a later stage. The first flight in this configuration took place on 15 February 1957. A series of 54 test flights was conducted during which the aircraft appeared to handle in a similar manner to that of the non-modified configuration at supersonic speeds. But it handled more precisely and responsively at subsonic speeds. There was also a better buffet threshold, improved aileron control feel and improved pitch response in the landing configuration. The test pilots certainly believed that the redesigned leading edge would be a useful improvement to be incorporated into production aircraft. English Electric's test data also convinced them that the revised wing would be worth adopting.

The Air Staff, however, eventually declined to accept the modification. This was an odd decision when compared to their evident desire to see the aircraft developed as fully as possible. The decision not to proceed was



A look inside the P.1B XA847's shock cone reveals some magnificent 1950's technology! The auto observer equipment illustrates how digital telemetry was still a dream of the distant future when the Lightning was created. (Photo: British Aerospace)

probably due to a report from A&AEE which had not been convinced that the modification was necessary. The establishment reported that handling with the unmodified leading edge was adequate for the skills of service pilots and that any small performance shortfalls at high speed and high altitude could probably be compensated for by 'a slight dive' or by the adoption of a rocket motor pack. Such a pack represented a further modification which was being

planned at the time. A&AEE's less than enthusiastic view may have been enough to eventually rule out adoption of the modification although, like so many potential improvements to the aircraft, cost may have been the deciding factor. The result was that the modified wing was abandoned for the time being. It did not reappear in the design process until the Lightning's final production variants emerged many years later, much to the frustration of English Electric and countless RAF pilots who considered the modification should have been incorporated right from the start.

On 4 April 1957 the first of the P.1B development aircraft, XA847, made its inaugural flight to mark the start of the next significant stage in the P.1 programme. It also effectively began the transition from what were essentially research aircraft and true prototypes. Although similar in outline to the two P.1A airframes, the P.1B incorporated many design changes. The most obvious differences included the appearance of the now-familiar shock cone positioned ahead of a new circular air intake trunk housing the Ferranti AI 23 AIRPASS equipment. The wings remained virtually identical to those of the P.1A before the leading edge modification, but the fuselage was noticeably different. It had been expanded to accommodate the slightly larger Rolls Royce Avon engines and incorporated repositioned and improved airbrakes. At the same time, the pilot's canopy was raised and bulged to improve visibility. The new canopy's aerodynamic profile necessitated a raised area running from the rear of the canopy to the base of the spine. This created space for the engine starting system which relied on the use of ignited AVPIN (Isopropyl Nitrate) to provide sufficient pressure to wind-up the Avon's turbine blades.

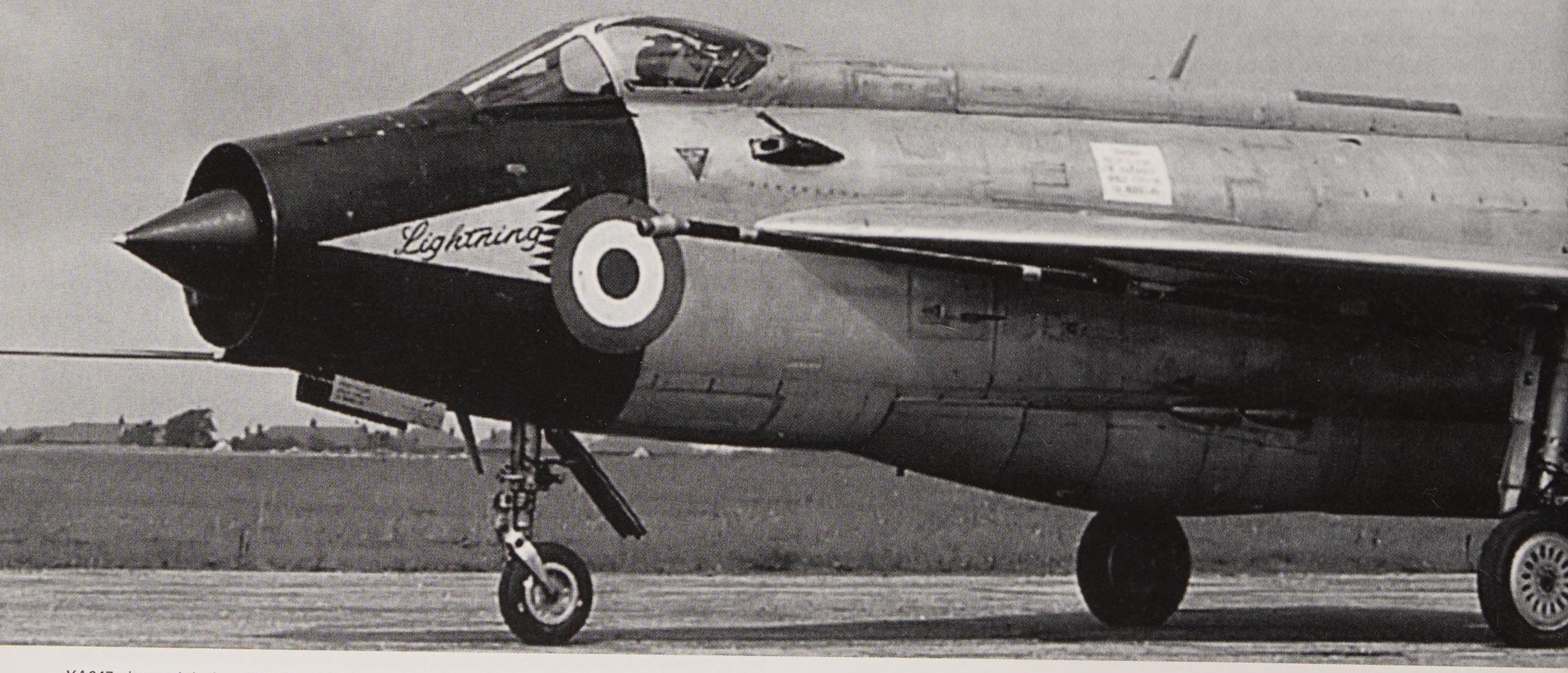
The concept of the starter system made sense because it enabled the aircraft to self-start without the aid of ground equipment. The 3 gal of Avpin stored in the spine provided power for up to six starts. This meant the aircraft would theoretically be able to operate anywhere in the world independently of ground starter support. Somewhat ironically, the starter system actually created mobility problems in later years when widespread airfield supplies of Avpin gradually dwindled. Unfortunately, the realities of the Avpin system were less attractive than the drawing board promised. Isopropyl Nitrate is a notoriously toxic, corrosive and volatile substance which had already demonstrated considerable difficulties and generated many horror stories of fires, explosions and damage. English Electric was already convinced that the system should be replaced by a simple cartridge starter. But official support remained in favour of Avpin, a decision pilots and ground crew members would ponder with some frustration over the next four decades.

Equipped with two Aden cannon, plus provision for a pair of DH Blue Jay (later to become Firestreak) AAMs and new RA.24 Mk.210 Avon engines each rated at 11,250 lb dry thrust, the P.1B represented a major advance on the relatively unsophisticated P.1A. Despite the various modifications, XA847 retained the tail fin seen on the prototypes, although this too was soon to be redesigned. The charge was largely dictated by the P.1B's revised fuselage shape which significantly affected directional stability.

The first flight of XA847 was certainly a great success. Having engines which delivered a combined thrust of 30,000 lb in reheat, greater than the aircraft's all-up take-off, the P.1B had a positive thrust-to-weight ratio. In theory, at least, the aircraft could climb without any aerodynamic lift at all. The new variable-nozzle system was not used for the first flight but Beamont reported that take-off acceleration in cold power felt similar to take-off in the P.1A with reheat. At 25,500 ft the aircraft was pushed to maximum cold thrust acceleration, reaching an impressive Mach 1.13/495 knots IAS.

Although 4 April 1957 should have been remembered as a particularly good day in the Lightning's history, it was probably one of the worst. While Beamont was taking XA847 through the sound barrier, the now-infamous White Paper produced by defence minister Duncan Sandys was being laid before the House of Commons. In it Sandys announced a radical shake-up of Britain's armed forces, with particular emphasis on the future shape of the Royal Air Force. Having concluded that the basis of future defence should lie with nuclear deterrence, Sandys announced that a whole range of promising aerospace projects would be abandoned on the grounds that they were either too expensive or incompatible with the new defence concept and corresponding reduction in world-wide commitments.

Many commentators have concluded that Sandys was little more than a butcher with no real understanding of Britain's defence needs. But he probably made the best decisions he could, based on the information he was given. Relatively rapid developments in surface-to-air guided weapons (SAGW) technology was showing great potential, giving defence chiefs the tantalising prospect of an all-missile system capable of destroying incoming enemy bombers without reliance upon expensive and vulnerable manned interceptors. Unfortunately, the enthusiasm for missile defence was based on far too many flawed assumptions, as former fighter pilot Bob Broad explains: 'It was and remains my opinion that the RAF wasn't getting good advice on defence technology in that era. To give an example, in 1954 I went on the short guided weapons course at the CAW Manby. At the end we had a lecture from a navigation specialist who explained that long-range rockets



XA847 pictured during A&AEE refuelling probe trials (note the camera trained on the probe's tip); the unusual 'RP3' ventral tank is also fitted. This was an early fuel tank design which included a recessed housing (just visible) for the nuclear-tipped Genie AAM which (had it been purchased) would have given the Lightning an awesome destructive capability. (Photo: British Aerospace)

After completing a successful test flight career, P.1B XA847 was transferred to the RAE and undertook a series of gravel bed over-run trials at Farnborough. Just visible is the unusual fin fillet which was fitted during early attempts to cure stability problems caused by the attachment of ventral tanks. (Photo: MoD PE)

would never be useful nuclear delivery systems as it would be impossible to achieve the required degree of accuracy. In 1958 when I was back at Manby on a lead-in course for the Thor IRBM we were told that long-range solid-fuelled rockets were impossible. Coupled with a certain amount of technical astigmatism was the malign influence of the electronic warfare enthusiasts who were attributing tremendous capabilities in that era to the Soviets. Their prevailing opinion was that everything could and would be jammed and hence came the reliance on guided missiles for air defence of the UK as it was thought (rather naively) that they would be able to home on the jammers.

'Once the threat became a jet bomber with a radar bomb sight and possibly a nuclear weapon, the current thinking no longer made sense. The USAF largely went over to radar-equipped single seat fighters for air defence. Indeed, I always assumed the presence of the F-86D wing at Manston was to provide some sort of credible defence of the USAF nuclear assets in the UK against attacks in bad weather, which the RAF could not at that time provide. Until then the RAF had apparently been planning to fight a "usual sort of war" with a training scheme in place to provide replacement pilots for those lost in combat. I always thought that consciously or subconsciously Fighter Command was planning for a re-run of the Battle of Britain. The advent of nuclear weapons in significant numbers changed the picture completely. So while the 1957 White Paper was seriously flawed, it would be wrong to dismiss it completely'.

Although the concept of SAGW defence was new in 1957, confidence in it was high and it was anticipated that an effective system could be operational in five or six years. Consequently, the idea of pouring significant amounts of money into development of fighter aircraft suddenly seemed pointless and wasteful. Although the very idea of replacing manned fighters with missiles might now seem absurd, it clearly seemed a plausible proposition in 1957. It resulted in aircraft like the rocket-powered Saunders-Roe SR53 and Gloster's 'thin wing' Javelin being abandoned. Miraculously, English Electric's P.1 survived. Many commentators have concluded this was simply because the project had proceeded too far to be cancelled economically. The reality was rather more complex.

The Air Staff had already accepted there was no guarantee that SAGW defences would be entirely effective or that they would become available

A rather poor-quality photograph which serves to illustrate the larger Stage Two tail fin which was progressively fitted to DB aircraft as stability trials continued. The larger fin proved adequate for the Mk.1 and Mk.2 Lightnings (with small ventral tanks) but an even bigger (Stage Three) fin was necessary to counter the instability created by the F.2A/F.6's larger ventral tank. (Photo: British Aerospace)

within the predicted timescale. Likewise, it was also accepted that the only effective way of defending the UK, particularly the nuclear bomber bases, against attack from Soviet bombers until a SAGW was fully operational would be a supersonic interceptor. English Electric's Freddie Page believed the aircraft survived cancellation because it had already become much more capable than the one originally proposed. It therefore suited the Air Staff's emerging requirements. Having started out as a simple gun-armed day interceptor, the P.1 had been developed into an all-weather, day and night fighter equipped with an advanced radar, guns, air-to-air missiles and with further potential for rocket armament.

It is also interesting to note that although the P.1B and subsequent production aircraft could justifiably have been officially designated as a completely separate design project – the original specification was revised to keep pace with the aircraft's projected capabilities – Page was careful to ensure the project was still regarded as being only a natural development of the P.1A. He believed it was this decision which encouraged the Government to continue with it. Presentation of a completely new specification and design, which would probably have been the P.5, together with all the necessary procedures would probably have been too much for the Air Ministry and the government to contemplate. Page's adherence to the original P.1 project may well have been an act of genius which ultimately saved it from abandonment. But in many respects, this survival was only a partial victory. The 1957 White Paper had far-reaching effects, not least the establishment of the notion that all manned fighters – including the P.1B – should be regarded as stop-gaps pending the arrival of technically superior missiles. It was undoubtedly the White Paper which fostered the fundamental and hopelessly misguided belief that the P.1B was little more than a temporary solution to a long-term requirement. This was to persist throughout the Lightning's service life.

Even though a variety of circumstances seemed to have contributed to the P.1 programme's survival, it is fair to say that by early 1957 the project had gathered a great deal of momentum. The promise of an operational aircraft being available to the RAF undoubtedly made continuing to fund the project rather more acceptable to the Treasury. By this stage, some three years had already passed since the Treasury had sanctioned the purchase of an initial batch of 20 pre-production aircraft more representative of the final operational design which would ultimately enter service – if ordered. Although the three P.1Bs were outwardly similar to the final production Lightning F.1, they were in effect the true prototypes. The two P.1As, usually regarded as the prototypes, represented an interim step between drawing board and prototype stage.

The 20 pre-production aircraft were intended to act as an extended 'prototype fleet', spreading the trials and development programme across a substantial number of aircraft. This was intended to avoid the difficulties, especially delays, which a small number of prototypes would have created. This had also been a particular problem with the Hunter. The idea had come from American experience but in practice it was flawed. This was chiefly due to the amount of time and resources required to keep the whole fleet, plus the three earlier P.1B aircraft, to a similar state of modification. Time which could have been spent on test flying was wasted on duplication, spreading continual modifications across no less than 23 aircraft. The batch of pre-production aircraft, in effect developed P.1B airframes, never received any official designation. The MoS insisted on them being referred to as development batch aircraft to avoid the term 'pre-production' which implied

A well-known photograph of a famous Lightning accident. DB Aircraft XG332 crashed just short of Hatfield's runway on 13 September 1962 following an engine fire which led to the catastrophic loss of the aircraft's tailplane actuator system. Test pilot George Aird ejected successfully but suffered the misfortune of landing in the middle of a greenhouse. (Photo: Tim McLelland collection)

a follow-on order. This would suggest that even by 1955 there was still no great confidence that a production batch would be financed.

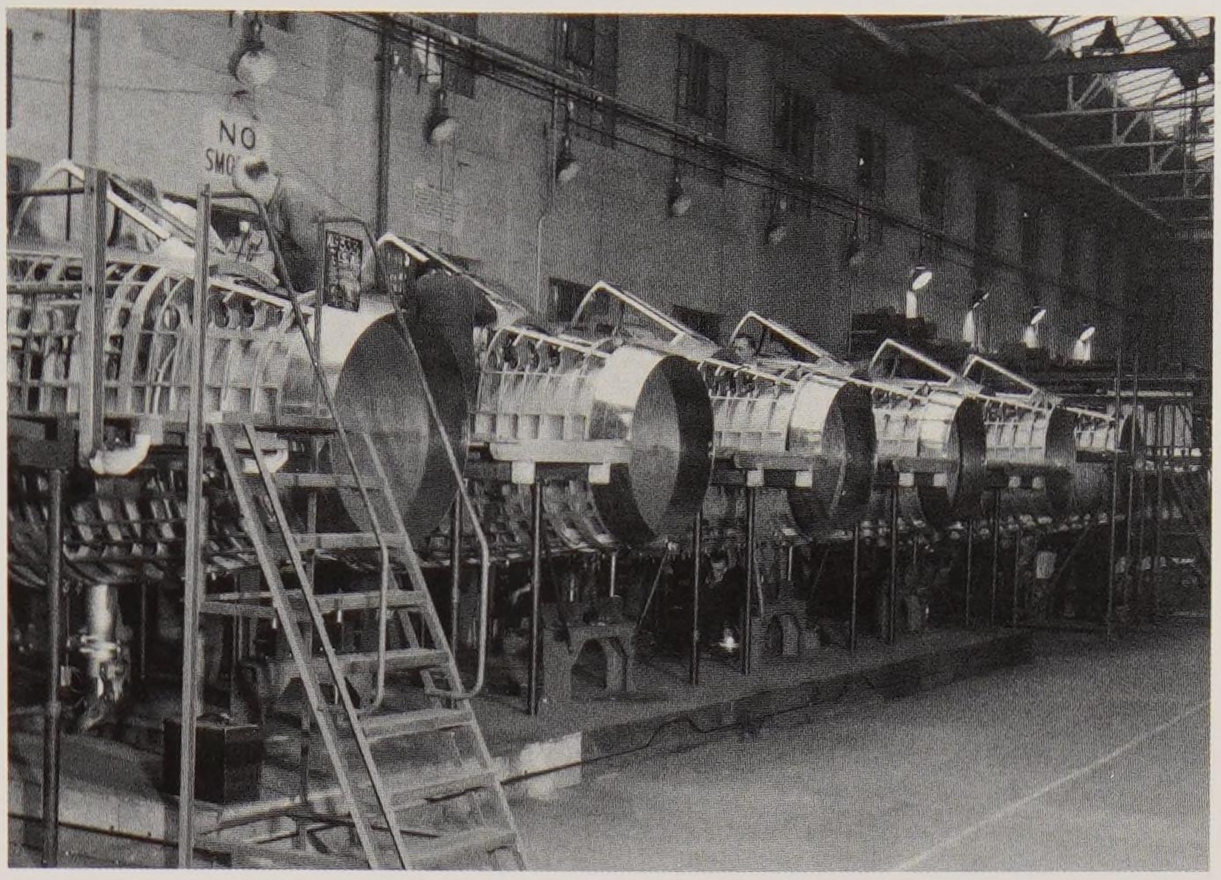
In fact, an order was finally placed in November 1956, a few months before the Defence White Paper, for 50 Mk 1 aircraft to Specification F.23/49. Meanwhile, the P.1B flight trials began to increase in intensity during 1957, the second P.1B (XA853) joining the test programme in June. Both aircraft were flown as frequently as possible to work through the test schedule. This often meant heavy workloads for the engineering crews who regularly worked long night shifts to prepare the aircraft for flying the next day. Serviceability was the main difficulty. It came as no surprise that a relatively sophisticated, high-performance jet would be difficult to maintain, especially in prototype form. But continual problems with fuel, hot gas and hydraulic leaks, combined with relatively minor electrical problems, ensured the flight test team was constantly struggling to keep up with the schedule. To compound the problems still further, the reheat system proved to be temperamental and regularly failed to ignite. This was particularly embarrassing for the test pilots when a variety of VIP demonstrations were required. These difficulties were magnified for the development batch (DB) as each aircraft reached completion and flight status, making matters still worse. For example, at one stage when seven aircraft were available for test flying, only one was serviceable for some weeks and the concept of maintaining such a large fleet of test aircraft began to look increasingly like a counter-productive move.

Despite these problems, good progress was made as more DB aircraft finally became available, enabling different aspects of the aircraft's performance envelope to be explored, together with the weapons systems and associated equipment. One of the highlights of the test programme came in 1958 when XA847 was assigned to explore engine and systems handling. Some flights had been quite eventful, particularly low level trials over the Irish Sea when Beamont occasionally experienced intake duct surges. This produced a great deal of noise which Beamont compared to cannon fire because it caused him to literally duck down in his seat. At the same time, the condensation emerging from intake shock waves illuminated by sunlight looked like flashes of flame, causing the pilot further alarm.

Having attained speeds of Mach 1.8 or more on some recent flights, the English Electric team was confident that with plenty of engine thrust still in reserve, the aircraft could go still further and a flight was planned which would take the P.1B up to Mach 2.0. Surprisingly, there was little official interest in the proposal, largely because the service requirement of Mach 1.7 had already comfortably been exceeded. But on 25 November the flight went ahead. Having climbed to 44,000 ft, Beamont selected full reheat and the aircraft accelerated to Mach 1.9 at which stage power was briefly reduced to check speed control. With full reheat re-applied, XA847 immediately surged back through Mach 1.9 and at Mach 1.98 Beamont reduced power to one-quarter reheat. This was sufficient to push the aircraft to Mach 2.0 at 42,500 ft. Almost effortlessly, the P.1B had reached twice the speed of sound.

Earlier in 1958, a team of pilots from the RAF's Central Fighter Establishment arrived at Warton to make their own 'preview' test flight appraisals of the P.1B. Although they were undoubtedly impressed by the aircraft's performance, they also highlighted deficiencies which would have to be addressed before production aircraft were completed. They were, for example, unimpressed by the temperamental Avpin starter system which consistently failed to function adequately and rarely produced a successful engine start on the first attempt. Even before getting airborne, they had identified the heavy braking pressure required on the foot pedals and it was agreed that this would probably be tiring (and therefore potentially hazardous) while taxying around long perimeter tracks. On arrival at the runway, the aircraft had to be carefully lined-up on the centreline. If not, differential braking was needed to keep it on the runway at the beginning of the take-off run until sufficient speed was reached for the rudder to become effective.

Once airborne the aircraft immediately had to be put into a climb to keep the acceleration under control until the landing gear had been retracted. The undercarriage limiting speed of 250 knots was reached seconds after take-off. Above this speed the landing gear, particularly the forward-retracting nose leg, could not function. The team also felt that the undercarriage retraction cycle was too slow. Maintaining the initial climbing speed of 450 knots IAS (indicated air speed) was easy, but after passing 18,000 ft and switching to indicated Mach number (IMN) 0.90, effective control was much more difficult. This was due to the relatively large fore-aft control column movements required and the poor design of the Mach meter which was difficult to read, particularly at subsonic speeds. After reaching the top of the climb, the pilots reported that the fairly



Forward fuselage assemblies being completed at English Electric's Strand Road factory in Preston, prior to being delivered to Samlesbury. In the foreground is the nose of DB aircraft XG333. (Photo: British Aerospace)

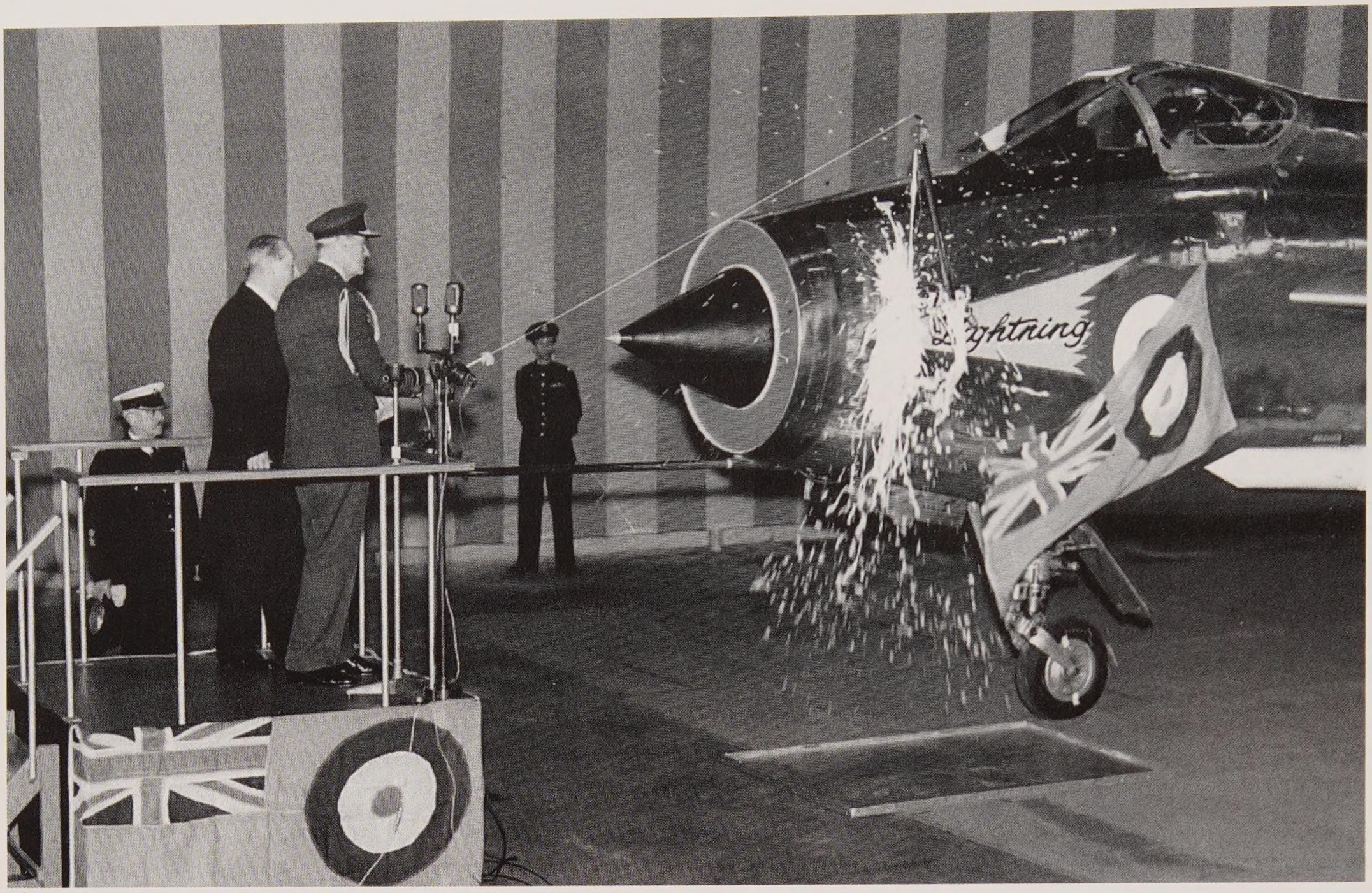
large control column movement required to push the aircraft over into level flight obscured their view of the attitude indicator – hardly an ideal situation. Likewise, some force had to be maintained on the control column until the tailplane trimmer caught up. If not, the aircraft would continue to climb.

General handling qualities were felt to be good. Rate of roll was exceptionally good, except at low speed when coarse aileron application could induce adverse yaw which needed to be corrected by a rudder input. Similarly, control below 220 knots was regarded as being rather poor. The reheat system was impressive but only when it actually worked and at speeds beyond Mach 1.0 or heights above 30,000 ft reheat light-up was particularly unreliable. Acceleration to Mach 1.0 was achieved in cold power at 28,000 ft before reheat was selected. Once in full reheat the acceleration was reported to be very rapid and great attention was needed to avoid climbing or exceeding the aircraft's limiting speed. Reheat was selected by pushing the throttles through the full cold power detent and cancelled by lifting a small catch to allow the throttles to be pulled back. The controls were thought to be rather clumsy, resulting in jerky movements which often caused the pilot to overshoot his desired setting.

Supersonic handling was reported as good although concentration was required in monitoring flight instruments during turns as there was a lack of harmony between the light control inputs required and the relatively heavy control column movements needed for the tailplane. It was felt that this could result in an unsatisfactory situation for an operational pilot busy working the radar at the same time. However, it was understood that production aircraft would have an auto-stabilisation and autopilot system which would rectify this problem. One rather interesting quirk of the aircraft's supersonic performance was the difficulty in attaining Mach 1.3. This speed was too high to maintain in cold power but was immediately exceeded with the use of reheat. Although application of airbrake would be appropriate in such a situation, it was felt that the redesigned brakes were still inadequate and that their variable positioning was unnecessary as they had to be fully extended when required. At lower subsonic speeds, forward visibility was found to be acceptable at circuit speeds but at slightly higher recovery speeds visibility was sometimes almost zero in heavy rain. The nose-down attitude maintained during descent caused the fuel gauges to consistently under-read, sometimes by more than 200 lb each.

This list of deficiencies was significant but most of the problems reported were not considered serious, especially when compared to the aircraft's many outstanding attributes. The CFE pilots agreed that it would probably be capable of achieving Mach 2.0 in RAF service, together with an operational ceiling of at least 55,000 ft. This would give the aircraft a comfortable performance advantage over potential adversaries like the Soviet Tu-16 Badger bomber. It would also give the RAF the capability it needed. Away from Boscombe Down, the P.1B fleet was assigned to a wide variety of trials, exploring every aspect of the aircraft's aerodynamic properties and equipment performance. Improvements and modifications were incorporated into the aircraft when necessary.

One of the most noticeable developments during the P.1B programme was the appearance of a new tail fin design, which was larger in area than those fitted to the first P.1Bs and the two P.1As. XA847 had demonstrated that



The Lightning's 'christening' ceremony at Farnborough, 23 October 1958. (Photo: British Aerospace)

the aircraft's directional stability was slightly degraded at very high speeds and as a short-term fix the aircraft was modified with a small dorsal extension to the fin. This proved to be a partial solution but a test flight limit of Mach 1.53 was imposed on the fleet pending more permanent fin design modifications, as faster speeds had already been successfully investigated and could be explored in more detail when the stability problem had been overcome. In May 1958 XA847 first flew with a completely new tail fin, this being the stage two design which became standard on the first production aircraft and proved to be sufficient to counter stability problems on aircraft fitted with the small ventral tank and carrying Firestreak missiles.

Following modification XA847 was assigned to air-to-air refuelling (AAR) trials, an important aspect of the test programme considering the aircraft's extremely critical endurance. Various designs for the aircraft's refuelling probe had been proposed, English Electric favouring a retractable probe in the port upper gun position. But by the time flight testing began in 1959, XA847 had adopted a rather more basic design, comprising a simple removable probe attached to the underside of the port wing. Inevitably, cost considerations had forced EE to adopt a less ambitious design. But it is important to bear in mind that at this stage in the P.1 programme, official interest in aerial refuelling was only connected with potential future overseas deployment. As a result, the idea of incorporating a permanent retractable probe system probably seemed unnecessary when a temporary bolt-on probe would be sufficient for the RAF's needs. With hindsight it seems incredible that an aircraft with such limited endurance, tasked with the interception of high-speed bombers, was not equipped with AAR equipment as standard from the outset. But as ever, the Air Ministry seems to have assumed that the P.1 would simply be required to climb rapidly to altitude and destroy incoming bombers. Little thought seems to have been given to the obvious attraction of intercepting such aircraft as far away from the British mainland as possible.

Flight trials involving Canberra and Valiant tanker aircraft were fairly uneventful, although Beamont did break-off the refuelling probe's tip nozzle on one early flight. XA849 received a coat of white fuel-sensitive paint across port nose and wing surfaces to trace the dispersal of waste fuel when connecting and disconnecting from the tanker basket. After the refuelling trials, XA847 was assigned to development of the cockpit centralised warning panel (CWP), an important part of the aircraft's internal equipment designed to monitor the integrity of the on-board systems. Because of the way so much equipment was effectively crammed into the P.1 airframe, English Electric was well aware from the outset that the risk of fire would always be a possibility. The CWP would enable the pilot to become immediately aware of any problems. But the early CWP system was prone to malfunctions and erroneous alarms which eventually encouraged the test pilots to almost ignore it.

On 8 May 1958 the CWP in P.1B XA853 proved its potential when it illuminated a fire warning during a test flight from Warton. On touch-down the aircraft's elevator controls immediately seized and by the time the aircraft had come to a halt, smoke was pouring from the rear. The cause of the fire was a hot air leak igniting pools of oil and fuel trapped in various recesses within the fuselage structure. The fire had caused so much destruction that the entire rear fuselage had to be replaced. More than a year was spent finding ways of ensuring that the near-catastrophe was not repeated. The fire detection system was redesigned and a limit of 20,000 ft was placed on reheat re-lights. But the risk of fire could not be completely eliminated. With two reheated engines squeezed so closely together within a cramped fuselage, the potential for problems was clear. In fact, the risk of fire was something which continued to plague the aircraft to the end of its service life.

The P.1B fleet continued to provide valuable test data. Aircraft were temporarily assigned to Boscombe Down for cannon firing trials, to Rolls Royce at Hucknall for engine and reheat development work, de Havilland at Hatfield for missile test flying, Ferranti at Turnhouse for radar development and elsewhere as required. The majority of test flying remained based at Warton, however, and in September 1958 two aircraft were dispatched to Farnborough to participate in the SBAC Show. It was on 23 October, while at Farnborough, that the P.1 was finally given a name. Choosing one had been the subject of debate since 1954 and with an established policy of assigning to fighters names suggestive of aggression or speed, a variety of potential names were put forward. These suggestions included 'Defender,' 'Arrow,' 'Scorpion,' 'Challenger,' 'Flash,' 'Astra,' 'Eagle,' and even 'Scimitar' and 'Harrier'. DCAS recommended 'Lightning' but official adoption of the name was delayed because the aircraft was barely at prototype stage. Further names were put forward such as 'Avenger,' 'Destroyer,' 'Excalibur,' 'Lancer' and 'Thunderblast,' but the Air Council concluded that Lightning would be the most appropriate name for the RAF's Mach 2.0 interceptor. An official champagne christening was conducted at Farnborough, with Chief of the Air Staff Sir Dermot Boyle officiating. At last the Lightning had been born.

Chapter Three

LIGHTNING LINEAGE

THE first production contract for the Lightning was placed in November 1956. It covered a batch of 50 aircraft, one of which was to become a static test airframe. Subsequently, the precise nature of the order shifted slightly, becoming divided into an early batch of 19 'interim' F.Mk.1 aircraft, followed by 28 'improved' F.Mk.1As, while two were cancelled completely.

The reason for this mixed order was the Air Staff's eagerness to get the aircraft into operational service. The P.1 programme had suffered many delays. Many were due to official confusion as to precisely how the aircraft should be equipped combined with a general reluctance to pursue the project. But there was a noticeable shift in attitude from around 1956, prompted largely by advances in Soviet offensive capability and the recognition that the RAF's existing fighter force of Hunters and Javelins was less than capable of countering this growing threat.

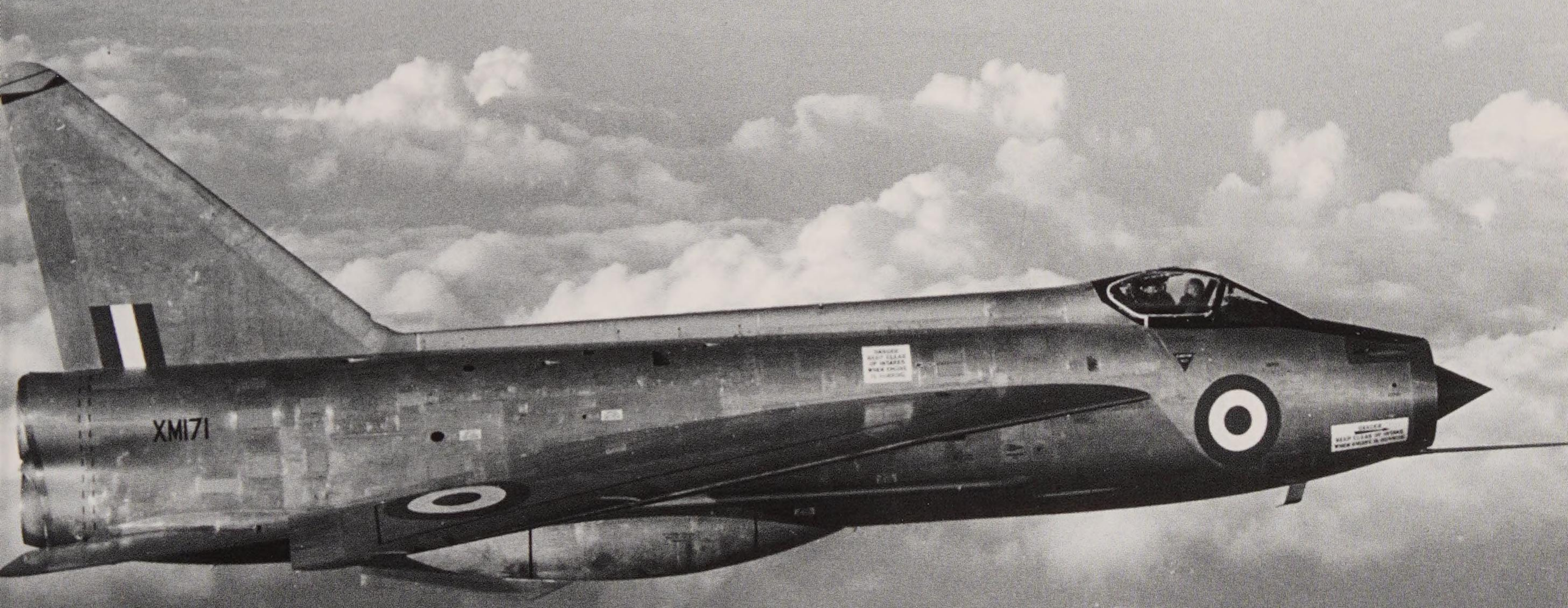
It also seems quite likely that as the nature of the 1957 Defence Review became clear, the Air Staff might also have been more willing to accept that the P.1 was likely to be all that was available and that it would make good sense to make the best of it. Despite defence minister Sandys being convinced that the way forward lay with surface-to-air missiles, the Air Staff consistently took a more realistic view, accepting that there was never any guarantee that surface-to-air guided weapons (SAGW) defences would prove to be adequate to defend United Kingdom airspace. Even in 1958, Sandys still appeared convinced that manned fighters would soon be redundant. He stated in a note to the Chancellor of the Exchequer:

'Since it is obviously no good equipping ourselves with aircraft which could not deal with Russian bombers of the period, we have no option but to provide Fighter Command with the P.1.'

This almost grudging acceptance of the Lightning was still on the understanding that it would be an interim solution on the basis that *'...we could be beginning the deployment of an effective SAGW defence which would probably not be fully deployed until 1965.'*

Of course, a fully effective SAGW system was never developed and failed to proceed beyond the Bloodhound SAMs which were deployed in key areas around the country, primarily to defend the vitally important V-bomber bases. The Bloodhounds were certainly capable of destroying incoming bombers but their reliability and relatively small numbers meant that they provided only a partial solution. The Bloodhound missile concept was flawed from its inception. Even under the most favourable interception circumstances, it could only destroy an incoming bomber when it was already perilously close to its intended target. Yet a manned interceptor, especially one with good range, could engage multiple targets at considerable distances. By the time that the deficiencies of the SAGW concept had become clear, the prospect of resurrecting any of the ambitious manned fighter plans which had been in existence before 1957 was no longer an option. Fighter Command's operational capability would depend on the Lightning.

The first production F.Mk.1 (XM134) made its first flight from Samlesbury to Warton on 3 October 1959. Following a series of 14 test flights, the aircraft was ready for delivery by March 1960 and test pilot Jimmy Dell flew the aircraft to Boscombe Down on the last day of the month. The A&AEE made a series of acceptance flights with the aircraft, although the long and detailed P.1B test programme had already established virtually every aspect of the Lightning's handling and performance. The A&AEE trials were therefore comparatively short. By the end of June the aircraft was ready to be delivered



The second prototype Lightning T.Mk.4 XL629 was transferred to the Empire Test Pilots School (at Farnborough) during 1967, receiving the unit's code '23' on the tail fin. The aircraft was later transferred to Boscombe Down and is still on static display at the base entrance. (Photo: MoD PE)

F.Mk.2 XN723 enjoyed only a brief flying career. After spending some time at Boscombe Down for handling appraisal, the aircraft was transferred to the care of Rolls Royce at Hucknall for Avon engine development work. Unfortunately the aircraft crashed in Leicestershire on 25 March 1964 following a fire emergency during which pilot Dennis Whitham safely ejected from the aircraft. (Photo: Steven Beeny collection)

to the Air Fighting Development School at RAF Coltishall, although the unit was temporarily located at Leconfield while Coltishall's runways were being resurfaced.

AFDS pilots eagerly flew the aircraft on a variety of trials flights, joining the development batch (DB) aircraft which had been with AFDS from the end of the previous year. They examined its operational capabilities and established the techniques and tactics required to use it in its intended role. It soon returned to Warton, however, so that the type could gain a full C(A) Release. It was not until 11 July that the RAF's first operational Lightning squadron (No.74) had a chance to become acquainted with the new aircraft when XM134 returned to Coltishall leading a fly-past to mark the return of the AFDS from Leconfield. The Squadron's CO flew the aircraft for the first time on 14 July and over the next few days the squadron's pilots eagerly followed.

Deliveries of new Lightnings began to trickle through from Samlesbury and Warton and eventually the entire production batch of F.Mk.1 aircraft (apart from the static test airframe, XM168) entered service with the squadron. From the perspective of the lucky pilots, the Lightning immediately lived-up to expectations, demonstrating a breathtaking performance when compared to the Hunter which most of the pilots had flown. All of the new Lightning pilots were experienced with at least 1,000 flying hours to their credit but less able pilots would have had no difficulty converting to the type. At the time there was no dual-control trainer variant. This effectively meant that any new pilot assigned to the Lightning made his very first flight and his first solo simultaneously. Such flights often proved to be 'interesting' but rarely resulted in any catastrophes.

The aircraft's radar system worked well and proved to be surprisingly reliable, in stark contrast to the problems associated with the Tornado F.2 interceptor more than 20 years later. The Firestreak missiles also functioned well, much to the surprise of some who were less than convinced that the growing reliance on AAMs was necessarily a good thing. From a flying and capability point of view, the Lightning's entry into RAF service was a great success. The ground crew who were responsible for maintaining the fleet took a different view, however. For them the Lightning's entry into service represented a dark period of frustration and hard work. It was already accepted that the aircraft would be challenging to keep serviceable but this assumption was soon proved to be an underestimation.

The RAF's problems were compounded by the fact that ground crews often comprised national servicemen who lacked sufficient specialised training. But even with the best possible training, the Lightning's many complex systems would have represented a technical nightmare for those tasked with their maintenance. Gaining easy access to so many of the Lightning's internal components was very difficult and time-consuming. This is not to suggest that the Lightning was significantly different to other aircraft of the same era but with hindsight it seems clear that the RAF was unprepared for the realities of maintaining a growing fleet of supersonic interceptors. Most importantly, the RAF's logistic system was poor and much unserviceability was the result of the RAF's inability to get sufficient spare parts to the right base at the right time. This situation was very slow to improve. Initially, most Lightnings could achieve no more than 20 flying hours per month even though English Electric insisted that 40 ought to be possible. They were right but many years were to pass before the RAF achieved this figure.

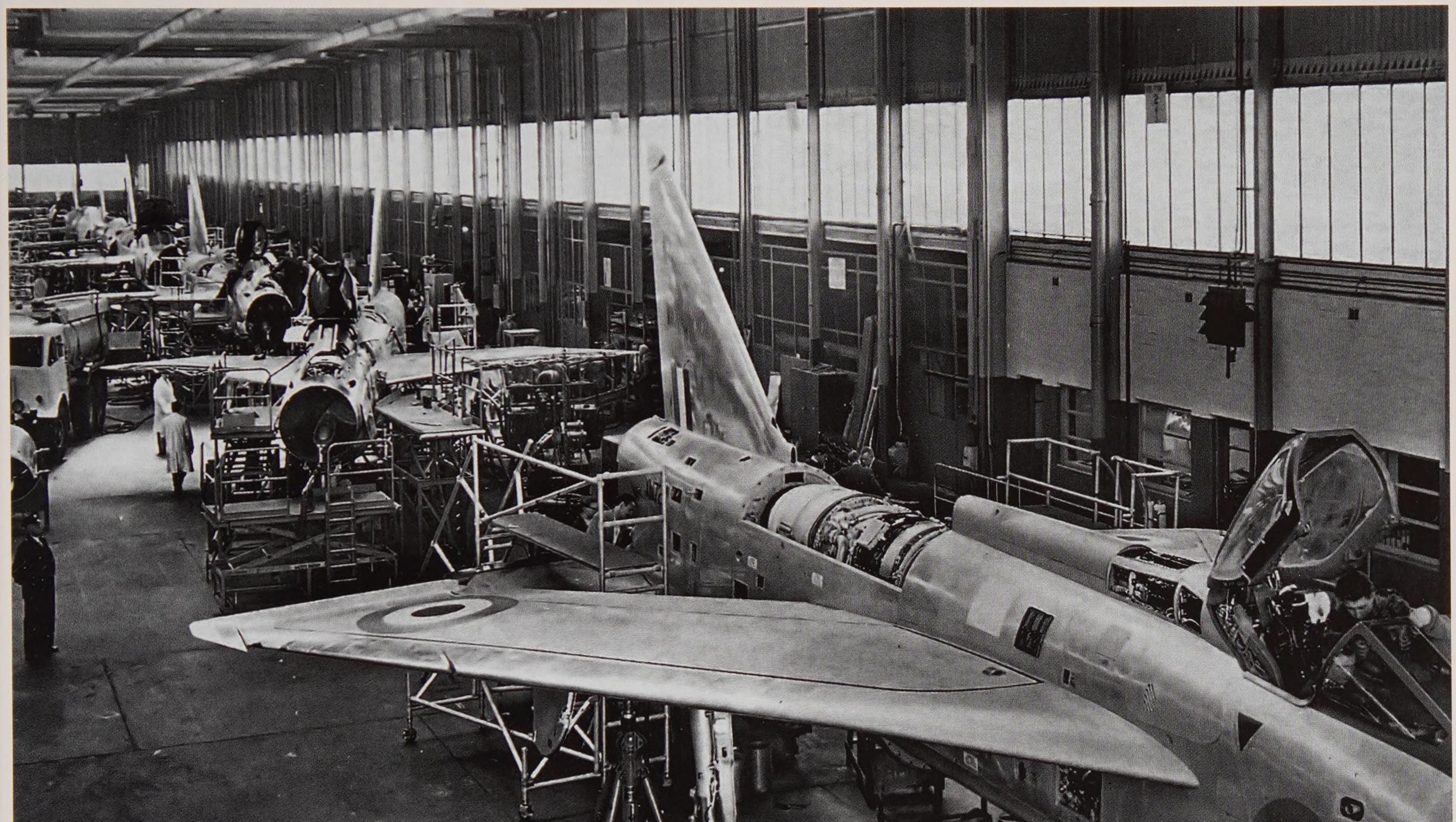
Keeping the Lightnings serviceable was a constant difficulty for No.74 Squadron during its early years with the aircraft. Many were withdrawn for repairs and modifications at various times. At one stage in 1961, when fuel leak problems developed in the aircraft's ventral tank, the squadron was forced to fly Lightning operations without them. This effectively restricted range to little more than a few miles from the airfield circuit. While it waited for a two-seat Lightning to be delivered, the squadron operated a two-seat Hunter for basic conversion and continuation training. Pilots maintained their

flying hours on both this aircraft and the Station Flight Meteor, enabling them to experience three generations of jet fighters simultaneously. As if these difficulties were not enough, No.74 Squadron had to cope with the inevitable public, political and service interest in their shiny new fighters. Having appeared at the SBAC Farnborough Show, the squadron was eventually tasked with providing a nine-aircraft formation as Fighter Command's official aerobatic team. But even with aircraft borrowed from the AFDS, keeping nine serviceable on a reliable basis proved impossible and the figure was reduced to seven. Yet the sight and sound of the Lightnings was enough to steal the show wherever the squadron went.

The small Lightning F.Mk.1 fleet was regarded as a short-term measure pending delivery of the more capable F.Mk.1A. This featured a series of improvements which were not developed in time to be incorporated into the early aircraft delivered to 74 Squadron. The F.1A had the advantage of a UHF radio and improved windscreen rain dispersal system, making the aircraft more suitable for all-weather operations. It was also 26 lb lighter than the F.1, weighing-in at 25,737 lb. Most importantly, the Avon 210R engine had a four-position reheat system, which was more flexible and reliable, and the aircraft was also equipped to carry the bolt-on refuelling probe now cleared for service. In essence, the F.1A was the true 'first generation' Lightning with which Fighter Command could begin to re-equip.

No.56 Squadron was the first to take delivery of the aircraft with the first (XM172) arriving at Wattisham on 14 December 1960. Three others were already being flown by A&AEE and English Electric (which became part of the British Aircraft Corporation after merging with Vickers and Hunting) on test and development work. The second aircraft to be delivered (XM170) never reached 56 Squadron. Having suffered mercury contamination, it achieved a pitiful 14 min of flying time before being relegated to ground instructional duties. It was therefore XM171 which became the second aircraft to join the squadron. Its last Hunter went in January and the rest of its Lightnings arrived in early 1961 to equip 56 Squadron with supersonic aircraft for the second time in the unit's history. Its first association with transonic flight had involved a brief spell with the troubled Supermarine Swift but the Lightning's introduction proved to be much less troublesome, not least because of the experiences learned from 74 Squadron's operations.

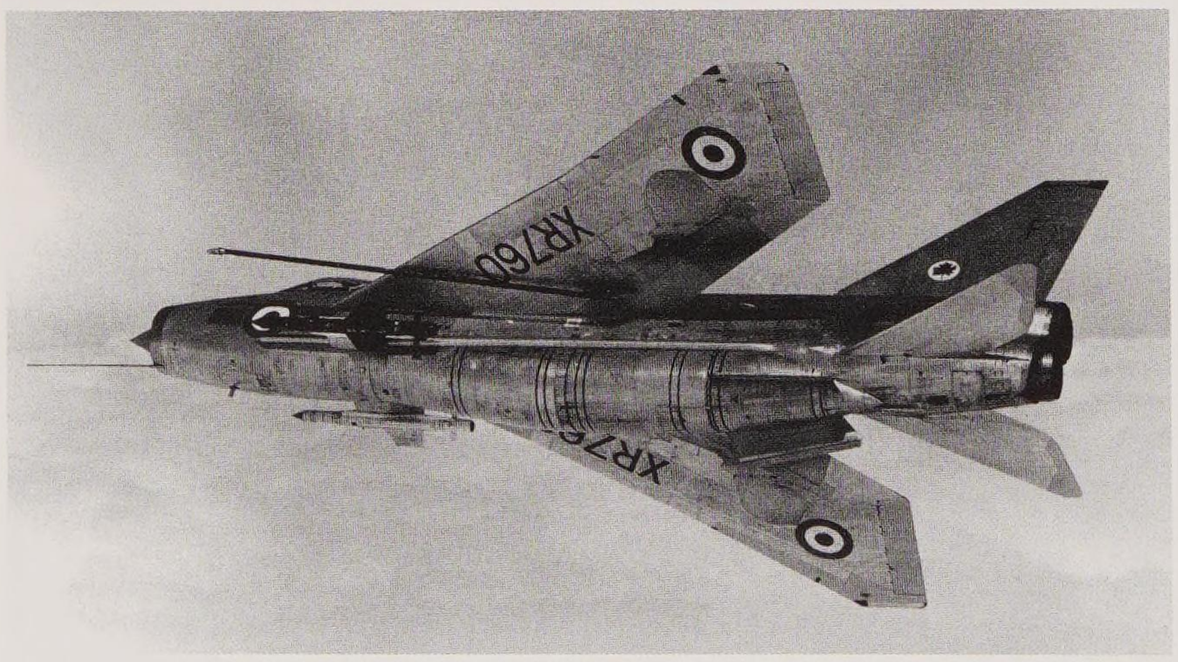
By 1962 the squadron was already able to demonstrate the flexibility afforded by the F.1A's AAR facility by deploying two aircraft to Akrotiri, Cyprus on a 4 hr 22 min flight supported by Victor tankers from Marham. Such was the success of the deployment that it was repeated a few months later with four Lightnings. The bolt-on refuelling probe became almost a permanent fixture on the squadron's aircraft until 1963. In that year the aircraft were assigned to the task of display flying, becoming the official Fighter Command display team, appropriately named the 'Firebirds' to reflect the squadron crest which featured a phoenix rising from the ashes. In a concession towards aesthetic appearance, the probes were removed and the aircraft repainted in a dazzling paint scheme comprising bright red trim across the tail, spine and wing leading edges. Less obvious to the observer was the removal of the radar (replaced by ballast) and the addition of two small pipes leading into the engine jet efflux. These were designed to pump diesel oil into the exhaust to create a flow of white smoke with which the Firebirds could enhance their aerobatic manoeuvres. The port wing flap's fuel tank was drained and isolated and diesel fuel was pumped into it to flow



Lightning F.Mk.2s on the production line at Samlesbury. (Photo: British Aerospace)

Pictured during a visit to RAF Luqa, F.6 XR929 eventually became a permanent overseas resident, as a static display aircraft (mounted on a plinth) at RAF Akrotiri (in 56 Squadron markings). (Photo: Dick Lohuis collection)

XN794 was one of only a few F.2 aircraft which were not converted to F.2A standard. Unusually, it also remained in service with 19 Squadron long enough to receive green camouflage in 1972 and remained active with the unit until 1974 at which stage it became an airfield decoy at Gutersloh. (Photo: Paul Tomlin)



XR760 was manufactured as an Interim F.Mk.6 aircraft, and modified to full F.6 standard during 1967. The only external difference between the standard F.6 and the Interim variant was the absence of an arrestor hook. XR760 was abandoned over the North Sea in 1985 following a reheat fire. (Photo: MoD)

out through a copper pipe conveniently housed in the port fuselage strake running along the Lightning F.1A's lower fuselage. This strake was in effect a redundant aerodynamic dummy, balancing the identical one on the starboard side which housed electrical wiring looms and instantly distinguished the F.1A from the earlier F.1. With an electrical pump switch on the control column's gun trigger, the squadron's Lightnings were able to add smoke to their display on demand.

The gradual improvement in the Lightning's serviceability enabled 56 Squadron to fly a formation of nine aircraft through the display season and perform a series of loops, rolls, steep wing-overs and level turns, together with a series of formation changes. Contrary to popular belief, the Lightning was an excellent formation aerobatics aircraft, having crisp, responsive handling combined with a huge amount of thrust. The only slight difficulty which affected both 56 and 74 Squadrons was the risk of damage to the tail fins from the turbulent air behind the exhausts of other aircraft. This led to a restriction on full nine-aircraft loops and rolls which required the display pilots to step-down the positioning of the trailing aircraft to avoid the risk of damage. However, it was probably no coincidence that the aircraft identified as having a loose fin tip was the one which had flown a significant number of refuelling trials flights positioned in a Valiant's jet efflux before joining the squadron.

Although 56 Squadron was still, albeit only technically, an operational unit, the demands of the 1963 air display season meant that virtually all of its time and manpower was devoted to display flying and the associated preparation and training. It was this severe drain on manpower and resources which ultimately ended the annual appearance of a Fighter Command display team. After No.92 Squadron took over in 1964, followed by 111 Squadron in 1965, the task of maintaining a Royal Air Force public presence was handed to the Red Arrows in much-less expensive Gnat trainers. Fighter Command's most glorious year was arguably 1963. The Firebirds captured the headlines wherever they went. The awesome sight

and almost indescribable sound of nine scarlet Lightnings trailing streams of white smoke in close formation was something that never failed to impress.

The Firebird's display season was not, however, without incident. On 6 June two aircraft collided during a display rehearsal at Wattisham after performing a crisp 'bomb burst' manoeuvre. At that stage the aircraft were separated by only six feet and XM179 was coming out of a left turn when the Lightning's wing struck the lower fuselage of XM181. This dislodged the starboard Firestreak missile but despite significant damage the aircraft recovered safely to Wattisham. However, XM179 entered a right-hand roll and, after making strenuous attempts to control the aircraft, the pilot, Mike Cooke, was forced to eject. But the ejection seat failed to function correctly and as a result of severe whiplash Cooke broke his neck and suffered severe injuries. He was ultimately discharged from the RAF as a paraplegic at the age of just 26. Astonishingly, the MoD failed to provide him with compensation or even a pension because he had insufficient service to qualify. It was, therefore, Sir James Martin of Martin Baker, manufacturer of the Lightning's ejection seat, who provided Cooke with two specially-adapted cars.

The Firebirds display comprised co-ordinated displays by formations of four and five aircraft but also included full nine-aircraft manoeuvres which were combined with a solo performance. Tragedy struck on 18 July when Alan Garside was killed at Wittering after becoming disorientated in cloud during aerobatic practice. Although his place was taken by another solo display pilot, it had become clear that despite the aircraft's outstanding performance capabilities, the task of giving polished and attention-grabbing public performances came at a heavy cost.

No.56 Squadron's Lightnings were joined at Wattisham by yet more F.1As when No.111 Squadron re-formed at the base, having finally relinquished its famous all-black Hunters. XM184 and XM186 were the first to arrive, on 13 April 1961, with re-equipment being completed by the end of August. While their sister squadron had eventually shifted most of its attention to formation display flying, 111 Squadron devoted its time to the less-glamorous but vital task of developing their air-to-air interception techniques. While 56 was thrilling air show crowds in 1963, many of 111 Squadron's crews were far away in Libya honing their air-to-air skills and even taking the opportunity to exercise the much-less regularly practised art of air-to-ground gunnery. This was a rarely-exercised secondary capability for an aircraft tailored to the role of supersonic interception.

Other deployments were made to Germany, Malta and Cyprus and the Lightning's serviceability remained at an acceptable level. At least, it seemed that way once the RAF's support structure had been improved sufficiently to meet the demands of the aircraft. There were still, however, occasional problems, not least during a short period towards the end of 1961 when virtually every Lightning was grounded for repairs to hydraulic pipes. Perhaps not surprisingly in an aircraft with so little internal room, the hydraulic pipes had become damaged due to contact friction and a system of clamps ensured the pipes remained comfortably separated. Other parts of the system were also fitted with shields and lagging to help remove some of the ever-present fire risks. While these vital repairs were being undertaken, UK airspace was largely undefended but the nation's vulnerability was not broadcast too loudly.

The F.Mk.2 followed the F.Mk.1 and F.Mk.1A into service. Apart from a small intake duct on the spine, the newcomer was identical in appearance to its predecessors. This might have led a casual observer to conclude that it was merely a refined version of the F.1A. But the F.Mk.2 was in fact a substantially better aircraft which represented an interim stage between the early production aircraft and the later 'second generation' machines. The F.Mk.2 was the first variant to be equipped with a CRT attack display, part of the planned instrument suite outlined in OR.946. This effectively made the F.Mk.2 the first all-weather Lightning variant with improved instruments, improved radar, four 30mm cannon, a standby DC generator and the Avon 210 engine which featured a fully variable reheat system, delivering a maximum thrust of 14,140 lb. A liquid oxygen system replaced the earlier gaseous system with its cumbersome and accident-prone pipework.

It was initially planned to equip the F.2 with the modified wing leading edge first explored on the P.1A. But although this became an accepted part of the various modifications incorporated into the F.2, with an agreement that the revised wing would then be capable of carrying wing tip external fuel tanks, the idea was subsequently dropped. The order for 50 aircraft, received in December 1959, was reduced to 44. It was at this stage that plans were first made to equip the Lightning with larger external fuel tanks carried on the wing upper surfaces, the lower surface being occupied by the main landing gear wells. But English Electric estimated that suitably modified wings equipped to transfer fuel from external tanks could only be incorporated into the production line at the 41st aircraft. Given that only four would therefore be available for modification, it was agreed that the modification would be held over until production of the Mk.3 aircraft began. This decision was also postponed still further.

Even without the wing modifications the F.Mk.2 was certainly a major improvement over previous Lightnings. The new instruments were effectively a 'partial' OR.946 suite but significantly better than the F.1/1A's austere fit. They were also capable of processing inputs from the master reference gyro and the air data controller, providing a navigation display which could give compass, ILS, UHF homer or TACAN readout. There was also provision for a data link facility, although it was never fitted. The radar B-scope could present a course for the pilot to steer manually and could also present programmed climb, altitude and heading hold, plus ILS track and glide information. A course could be flown automatically by the autopilot system. This, combined with a much less temperamental engine, made the F.2 a popular aircraft with every pilot fortunate enough to fly it. In subsequent years it has become regarded as the 'best of breed' in terms of capability and handling qualities. But it was slow to reach operational service thanks largely to the continued delays in completion of the OR.946 instrument system. Designed and developed under the control of the MoS and RAE, the system was to have been supplied to EE as fully approved and functional. But the company soon found that the various components did not work together satisfactorily and that the programme had clearly been badly supervised and co-ordinated. Consequently, its engineers had to re-test and renew the tolerances of each component as a total system, taking into account likely service deterioration. This process delayed the F.2's delivery schedule by many months.

The first F.2 to fly (XN723) took to the air on 11 July 1961. But the delays with OR.946 meant that the airframes were completed ahead of the intended instrument fit. This meant that they emerged from the Samlesbury factory only to be ferried to nearby Warton where they were stored before being stripped-down again and refitted to production standard. Consequently, it was 14 November 1962 before the first aircraft (XN771) entered service with the AFDS, now located at Binbrook, with the first aircraft joining No.19 Squadron at Leconfield on 17 December. By this stage, plans were already in hand to introduce the next Lightning variant. Despite the F.2's significant place in the story of the Lightning's development, its service introduction was somewhat overshadowed by the delays in getting it into service, combined with the prospect of a more capable variant just months away. Although the first F.2 had reached No.19 Squadron during mid-December, the next delivery did not take place for many weeks. The scheduled second aircraft failed to arrive on 9 January when XN778's flight was curtailed by technical problems and it diverted to Finningley where it remained pending repairs. It was not until April 1963 that the squadron received its final delivery from Warton.

No.92 Squadron was the next unit to receive the Lightning. The first aircraft (XN727) had arrived at Leconfield on 23 January with the final one delivered during August. By 1964 both Leconfield squadrons were operational on the Lightning and No.92 Squadron had the honour of becoming that year's Fighter Command display team, making the now-customary show-stealing appearance at the annual SBAC Farnborough show. The unit's stay at Leconfield was short because the Air Staff had decided to deploy two Lightning squadrons to Germany. With a requirement for 12 operational Lightning squadrons, Treasury pressure eventually reduced this figure to ten. Of these, one would be assigned to the Far East (Singapore) and another to the Near East (Akrotiri), while a further five would be based in the UK. All these units would ultimately be equipped with Mk.3 aircraft (in effect to become the F.6) and in most cases these would be capable of rapid overseas deployment should reinforcement be required. With east-west tensions still high there was an ever-present need to have two fighter squadrons assigned to the defence of German airspace, particularly the Berlin corridors. As the Lightning F.2 lacked sufficiently 'long legs' for rapid deployment from the UK compared to later proposed variants, it was decided that the two Leconfield squadrons would be the most appropriate for permanent relocation in Germany. No.19 Squadron began its transfer to Gutersloh on 23 September 1965 followed by 92 Squadron after a brief stay at Geilenkirchen from 29 December. Because of the rapid advances in the Lightning's design, work on the later Mk.3 variant was proceeding almost in parallel with the earlier F.Mk.2 and some consideration was given to modifying the F.2 fleet to F.3 standards. The prospect of saving more than £10 million was enough, however, to convince the Air Staff that the programme

XS417 was the first production Lightning T.5 to fly, joining the OCU at Coltishall during May 1965. It is pictured eleven years later whilst serving with the Lightning Training Flight, still wearing partial markings of No.56 Squadron. (Photo: Terry Senior)

F.Mk.1 XM139 was first assigned to No.74 Squadron prior to joining the OCU. In later years the aircraft served with both Leuchars and Wattisham Target Facilities Flights (Wattisham TFF illustrated) and was used as a solo aerobatic display aircraft during 1970, appearing at both Farnborough and Paris shows. (Photo: Dick Lohuis collection)

was unnecessary. For the time being, therefore, it was abandoned. It could be argued that the RAF over-ordered the F.2 and records do show that many F.2s spent a significant amount of time in storage with No.33 MU at Lyneham. Approval to begin design work on the Lightning Mk.3 was given in 1959.

The production contract for 47 aircraft was placed in June 1960, although, as ever, there was an almost grudging acceptance that an order needed to be placed. The Secretary of State for Air wrote in a letter to CAS that he understood: *'...it is now necessary to place follow-on orders for the Lightning and that your department, in consultation with the MoA, are seeking authority from the Treasury to convert an existing order for materials into a full production order for 47 aircraft. I have been reluctant to see further orders for Lightnings placed in advance of general decisions on provision for air defence; nevertheless, I am prepared to support the ordering for these aircraft and to see both the Mks.2 and 3 brought up to the full operational requirement for the Mk.3 in due course. This will, I understand, suffice to maintain a front-line strength of 60/72 aircraft of Mk.3 standard. I must make it plain, however, that on the information now available to me, I am not prepared, either, to see any further orders placed for Lightnings, or for the Lightning to be developed beyond Mk.3 standard.'*

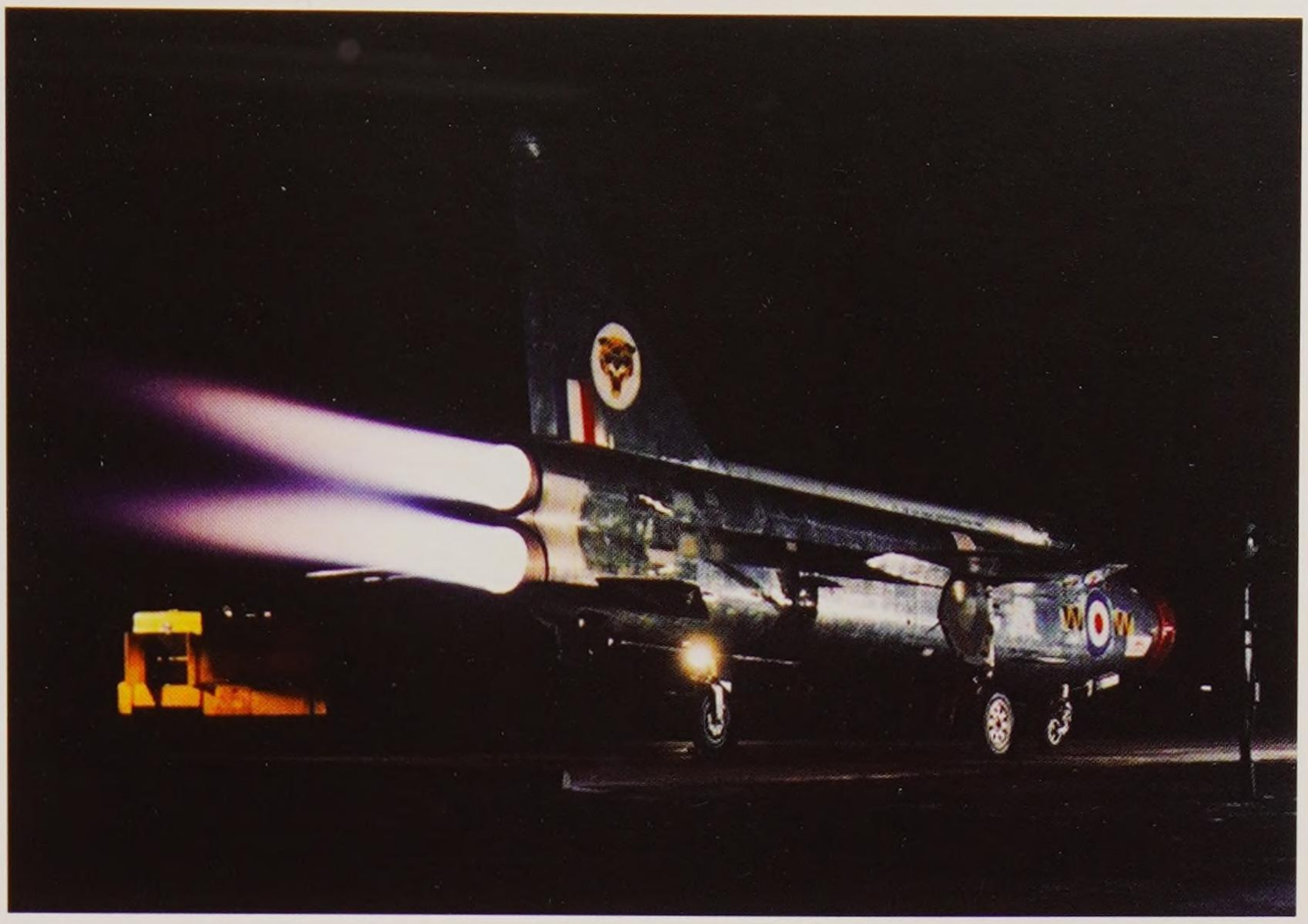
The Chancellor of the Exchequer was even more forthright: *'On the basis of existing plans, annual expenditure on air defence, at current prices, seems likely to be up by about 20 per cent by 1964/5. This is, to me, an entirely unacceptable prospect. On the contrary, a substantial and progressive reduction from the current level seems an absolute necessity.'*

Given this attitude it is little wonder that the Lightning programme faced an uphill struggle to secure funding for even the most basic level of improvements. The government was still deluding itself into believing that SAGW defences might somehow render the manned fighter obsolete and that effective air defences could somehow be acquired on the cheap. Despite the Secretary of State's comments, an order for an additional 45 Mk.3 Lightnings was eventually placed, in January 1962, after further (presumably rather heated) discussions had taken place towards the end of 1960.

The Mk.3 was the second generation Lightning, built around two Red Top AAMs. The P.1 had started life as a purely cannon-armed interceptor with no initial interest in AAMs expressed by either the Air Ministry or the manufacturer. But the rapid development and undeniable success of the de Havilland Firestreak fitted to the earlier Lightning variants eventually shifted official interest towards the perceived potential of the missile at the expense of the tried and trusted Aden cannon. This process culminated in the decision to remove all cannon armament from the proposed Lightning F.Mk.3 to provide facilities for two Red Top missiles, originally referred to as Firestreak Mk.IV. Although the Firestreak had proved to be effective and reliable, it was undoubtedly hampered by its inability to engage a target from anything other than a stern approach.

Naturally, this limited the Lightning pilot's options and the much-improved Red Top promised the ability to attack from any angle, head-on if necessary. The Red Top had a new seeker head fairing – a single dome in place of the earlier faceted design – and revised control surfaces, together with a more powerful 68 lb warhead. The improved seeker head, which provided the all-aspect capability, was matched to an improved rocket motor which gave the missile a range of more than seven miles. The earlier redesign of the DB aircraft's tail fins had resulted in the 'stage two' fin fitted to all subsequent aircraft as well as being retrofitted to the majority of the DB fleet.

This larger-area fin improved the Lightning's directional control and stability but EE soon concluded that an even bigger one would be desirable. As the Mk.3's Red Top missile threatened to slightly degrade directional stability, it was decided to design and manufacture the 'stage three' fin. This incorporated another 15 per cent increase in area, effectively broadening the chord of the upper surfaces which were cropped to produce a square-cut fin tip. To expedite progress on the F.3 programme, one of the DB fleet (XG310) was selected to act as an aerodynamic test bed for the new variant. It was dispatched to the Boulton Paul airfield at Seighford where it was fitted with a new stage three fin together with the necessary internal frame strengthening. The aircraft subsequently appeared at the 1963 SBAC Show billed as being the prototype Mk.3, although the true prototype was actually XP693. This



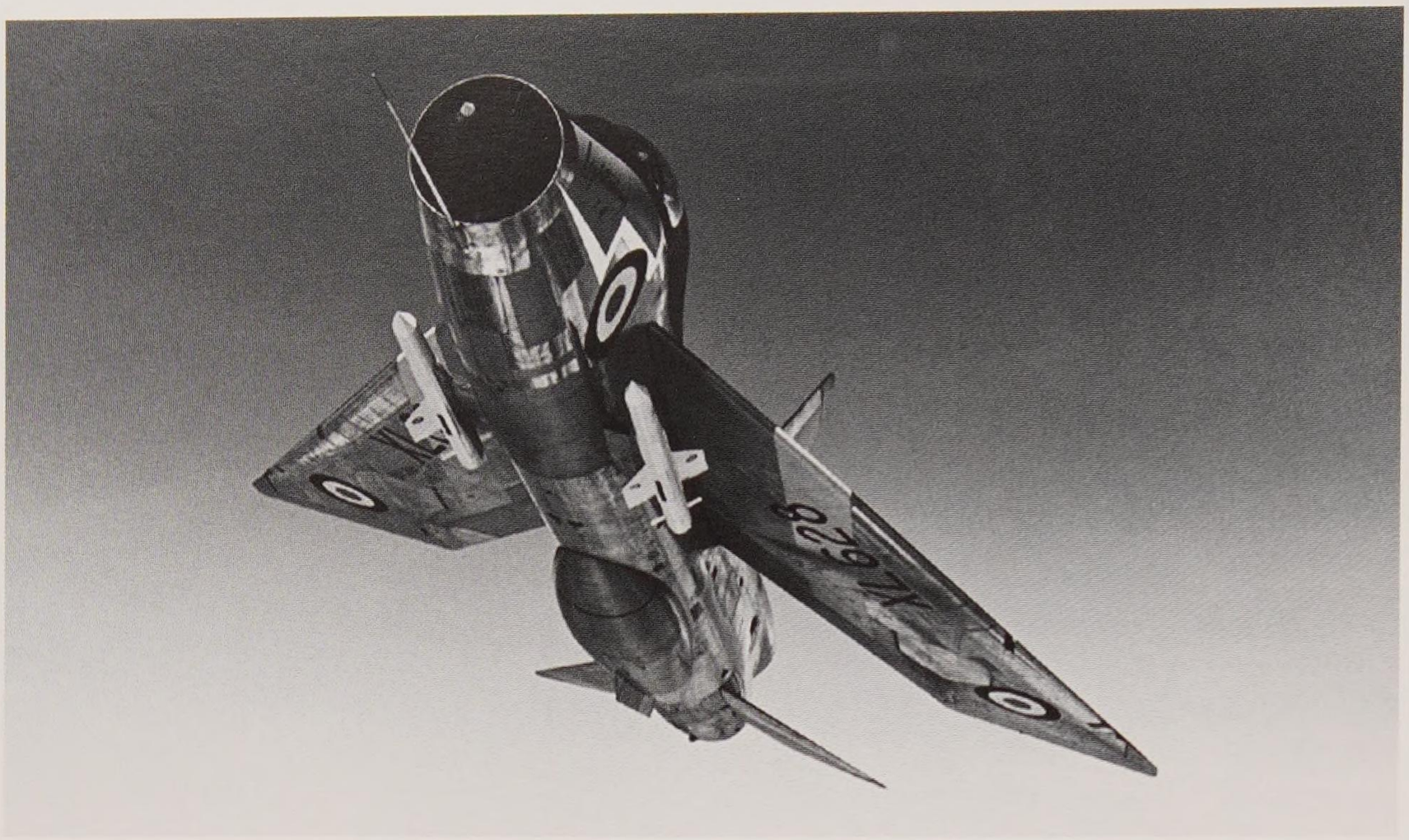
A well-known English Electric photograph showing Lightning F.Mk.1 XM145 undergoing engine runs in reheat at Warton, following post-fire repairs in 1962. (Photo: British Aerospace)

emerged from the production line almost a full year ahead of the remaining F.3s, having been rushed through the factory so it could be delivered to Boscombe Down for C(A) Release trials as rapidly as possible. Three further DB aircraft were subsequently modified by Boulton Paul to carry stage three fins and, after being fitted with up-rated engines, instrumentation and Red Top systems, they were all assigned to the F.3 development programme.

Although future developments created a different outcome, at the time of development the F.Mk.3 was expected to be the ultimate Lightning variant. The Red Top all-aspect missile was at the very heart of the design, so much so that the once-obligatory cannon was deleted completely. This decision was clearly a mistake. Externally the aircraft was similar to the F.2 with the exception of the new larger fin and slightly longer cable ducting along the fuselage sides. Internally, a great deal was different, particularly in the cockpit. There the new Red-Top-configured AI.23B radar was linked to a new display, comprising search and attack CRT, 'S' band homer and a light fighter sight system together with AI/autopilot coupling and 'S' band homer/autopilot coupling. The traditional dial instruments were partially replaced by a new strip display. This partially addressed the deficiencies of the older instruments which often caused the pilot's awareness to lag behind the aircraft's true speed and altitude. But it led some pilots to conclude that the unusual presentation system created more problems than it solved. Within the airframe a new fueldraulic system was fitted with a wing-to-wing transfer facility, larger main undercarriage jacks and a cross-linked flap hydraulic system which reduced the risk of asymmetric flap deployment. The Avon engine was the new Mk.301 featuring fully variable reheat and delivering a maximum reheated thrust of 15,980 lb. This gave the aircraft a much improved rate of climb, better manoeuvrability and higher maximum speed, enabling service clearance to be given for routine operations in excess of Mach 2.0.

Two aircraft were also taken from the F.2 production line to assist with F.3 trials. Both were upgraded to F.3 standard and fitted with the much-discussed over-wing fuel tanks, which would have been fitted to the entire F.2 fleet had the decision to adopt them been taken in good time. The tanks were subsequently abandoned as the Air Ministry saw no good reason for equipping the fleet with subsonic tanks which would have to be jettisoned before attaining supersonic speed. With the benefit of hindsight it now seems obvious that any opportunity to increase the Lightning's range – even if only for ferry flights – ought to have been eagerly accepted. But as was always the case with the Lightning programme, cost considerations and short-termism triumphed over logic.

The first F.Mk.3 production-standard deliveries were made to the Central Fighter Establishment at Binbrook, where they were immediately assigned to evaluation and trials flights, enabling the RAF to establish the necessary tactics and operational procedures. It was No.74 Squadron which took



Classic Charles Brown photograph of the prototype Lightning T.Mk.4 XL628 complete with 1959 SBAC show colours and suitably-decorated dummy Firestreaks.

delivery of the first operational-standard aircraft (XP700) which arrived at its new base of Leuchars on 14 April 1964. Three months later the squadron relinquished its last first generation Lightning F.1A. On 19 August the first two Lightning F.Mk.3s (XP707 and XP708) for No.23 Squadron arrived. This enabled the unit to relinquish the Gloster Javelin, an aircraft which had performed well in the all-weather fighter role but was completely outclassed by the Lightning's speed and manoeuvrability.

Being located in Scotland, the Leuchars-based Lightnings inevitably took more than their fair share of QRAs (Quick Reaction Alerts). Lightning pilots were regularly scrambled to intercept Soviet Bears and Badgers, which were skirting UK airspace with increasing frequency. The time and fuel necessary to get the aircraft from the airfield's main apron was obviously wasteful. Although Hunters had traditionally been positioned on concrete pads next to the runway thresholds, often rendering aircraft unserviceable after standing in the open for long periods, the rather more complex and temperamental Lightnings needed a more benign environment in which to await the call to scramble. QRA shelters, colloquially referred-to as 'Q-sheds' were, therefore, constructed at Leuchars, Binbrook and Wattisham. There was a similar shelter at Gutersloh for the Germany-based units. Each shelter was designed to house two Lightnings next to the runway threshold. Pilots and ground crew had their own accommodation beside the shelter and this enabled pilots to race to their prepared aircraft, start-up and roll straight out to the runway. Once the order to scramble was given, the aircraft were airborne in a matter of seconds. Every Lightning scramble also required a Victor to be scrambled from Marham or diverted from a sortie already in

No.74 Squadron's Lightning F.Mk.1s shortly after introduction into RAF service at Coltishall. (Photo: British Aerospace)

progress to support the short-legged interceptors on their lengthy missions.

Wattisham was the next station to receive the Lightning F.Mk.3 with the first aircraft (XP741) for No.111 Squadron arriving in December 1964. Two months later the first F.3s for No.56 Squadron began to arrive and almost immediately squadron personnel turned their attention to decorating their new aircraft even more colourfully than the existing F.1A fleet. The result was a bright red spine, a futuristic arrowhead design on the nose and an almost jaw-dropping red and white chequerboard design emblazoned across the tail fin. The Lightning squadrons had enthusiastically embraced revising the colourful pre-war markings applied to fighter aircraft and 56 Squadron's efforts were certainly the most eye-catching. They also proved to be the last. Some less-imaginative senior RAF officers took the view that combat aircraft should be decorated more conservatively. By 1966 the markings which had adorned so many Lightnings were gone except for those displayed by No.92 Squadron whose location in Germany placed it outside the new ruling. Air and ground crews were saddened to lose the opportunity to foster their squadron's *esprit de corps* on such a grand scale. But official short-sightedness had again got in the way of plain common sense.

F.Mk.3 XP750 pictured at Wattisham whilst serving with No.23 Squadron in 1975, shortly before being transferred to Binbrook. (Photo: Terry Senior)

When No.56 Squadron was fully operational on the Lightning F.Mk.3, it was announced in February 1967 that the unit would be transferred to Cyprus to replace No.29 Squadron's Javelins as the primary defenders of NEAF airspace. After ferrying the Lightnings to Akrotiri in two waves, the squadron officially took over on 11 May. Assigned to Cyprus Sovereign Base Area (SBA) defence, the aircraft were held at various states of readiness. During the 1967 Arab-Israeli war the alert state was raised and the squadron's F.Mk.3 were re-armed with Firestreaks. The fact that the F.3 was capable of carrying both generations of AAM suggests that the Firestreak was regarded as rather more reliable than the Red Top despite its limited aspect deficiencies. No.29 Squadron re-formed at Wattisham as the final all-F.3 squadron, being declared operational on 16 August. This effectively completed Fighter Command's re-equipment with the Lightning after some seven years.

The Lightning F.Mk.3 had long been regarded as the definitive variant which would represent the end of the type's development. But circumstances continually changed throughout the procurement process and the Air Staff's requirements shifted with regular and frustrating frequency. By the end of 1960 it had been decided that Fighter Command's fundamental role should be redefined. It should now be referred to as the investigation of unidentified aircraft, the prevention of enemy aerial reconnaissance flights, prevention of attempts to jam radar systems and – perhaps most significantly for the Lightning – the supply of reinforcements for overseas bases and commitments. This translated into a distinct shift from the Lightning's original role as a point defender to a more flexible aircraft which could intercept a target and stay with it for a considerable time.

It also meant that the aircraft needed to be capable of reaching overseas bases efficiently and swiftly without relying on expensive and logistically-challenging tanker support. Ironically, it had been specified during the infamous 1957 Defence Review that the Lightning would be confined exclusively to the defence of UK airspace and would not be required to deploy overseas. Even in the UK it had been envisaged that it would represent no more than a back-up to the proposed SAGW defences. Yet just a couple of years later the aircraft was placed at the very heart of the RAF's defensive structure. It was destined for Germany, the Near East and Middle East and regarded as the primary airspace defender rather than merely secondary to missiles. So far there had been little official interest in the Lightning's limited endurance but now attention was finally drawn to ways of extending the aircraft's range. This would have been addressed from the very beginning of the P.1 programme had the Air Staff been wise enough to recognise the necessity.

It was quickly accepted that the early Mk.1 Lightnings would not be worth improving. Some consideration was given to equipping them with bolt-on refuelling probes like the F.Mk.1A but the idea was dropped. More serious was the possibility of equipping the F.Mk.1A and F.Mk.2 with overwing fuel tanks. But as this would effectively mean the construction of new wings the idea was too costly to adopt, although English Electric did offer the possibility of designing smaller 100-gallon drop tanks which could have been carried under the existing wings. This idea was also abandoned. Ultimately, no attempts were made to improve the range of the F.1 or F.1A, although the F.2 was eventually modified, as described later.

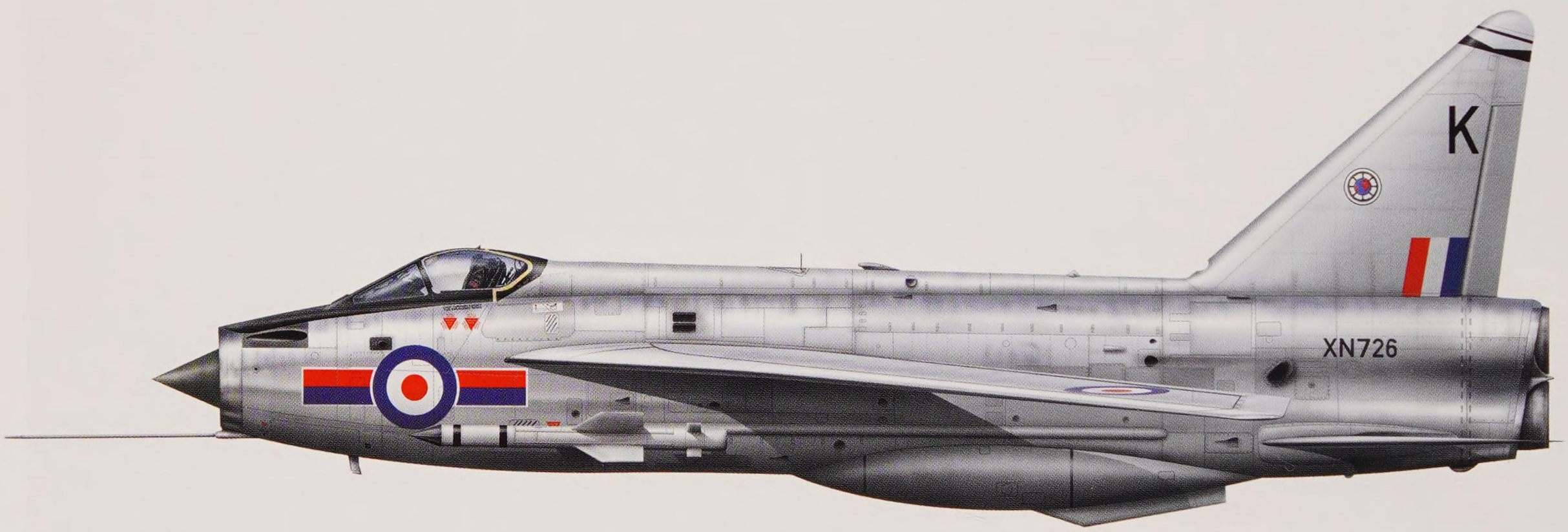
Attention was concentrated on the Mk.3. This was in effect the standard variant which would remain in active service in significant numbers. The most obvious means of improving its endurance in addition to the now-standard bolt-on refuelling probe was to redesign the relatively small ventral tank which was identical to that carried by the earlier variants. English Electric had already looked at the concept and an enlarged fairing had been flown on XA847. However, this new fuselage attachment, manufactured by Boulton Paul, was primarily designed to house the RP3 store – the American nuclear-armed Genie rocket which had been a potential weapon for the Lightning until official interest waned. The extended fairing not only provided accommodation for the missile in a recessed launcher but also created space for additional fuel. The Air Staff now wanted the aircraft to have a 2,000-mile ferry range with one in-flight refuelling. This indicated that the existing ventral tank should be redesigned and enlarged and that overwing tanks should also be available.

English Electric produced a variety of designs to meet this requirement, all with various capacities, but all having an effect on aircraft performance depending on the tank's proportions. It was also accepted that the wing leading edge could be modified to improve subsonic cruising efficiency. Having previously abandoned any interest in the CLE (cambered leading edge) the idea was resurrected. The absurdity of abandoning proposals and subsequently reviving them was a common occurrence during the Lightning programme but in the case of the CLE the reasoning was simple. The modification certainly improved handling and range at subsonic speeds but it had a detrimental effect on supersonic performance. This was sufficient to discourage interest in modifying first generation Lightnings with Avon 210 series engines but the F.Mk.3's Avon 301s would provide sufficient thrust to overcome the CLE wing's supersonic penalties.

By the end of 1961 it had been agreed that the F.Mk.3's range would be increased by replacing the small 250 gal ventral tank with a much larger 560 gal pack whose capacity eventually rose to 600. This, combined with

LIGHTNING F.1, XM165, 74 Squadron 1960

C/N 95046 ff R.P. Beamont 30.5.60. To 74 Sqn (coded F) 29.6.60. To Modification centre Leconfield 9.7.63. To 226 OCU (165) 6.9.63. To 33 MU Lyneham for storage 2.9.64, last flight with 532 hours. Sold as scrap to B.A. Taylor, Bromwich, 11.66.

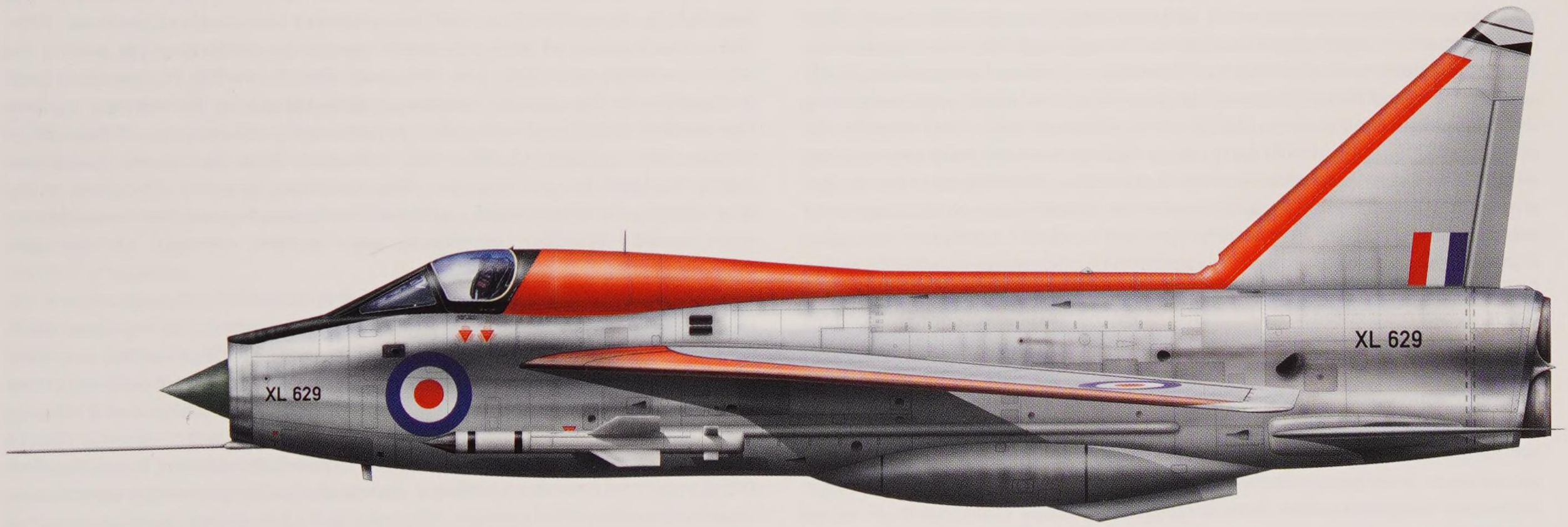


LIGHTNING F.2A, XN726, AFDS 1963

C/N 95098 ff J.K. Isherwood 29.9.61. AFDS (K) 14.2.63. To 33 MU Lyneham for storage 10.6.64. To Warton 19.10.66 for conversion to F.2A standard. 19 Sqn (D) 6.68. To Warton by road 26.5.72 following lightning strike. To 92 Sqn (N) 13.5.74. To RAE Farnborough 4.4.77, last flight with 2222 hours. Allocated 8545M, transported to P&EE Foulness Island 23.11.78. Scrapped 2.96. Nose section preserved at Boscombe Down.

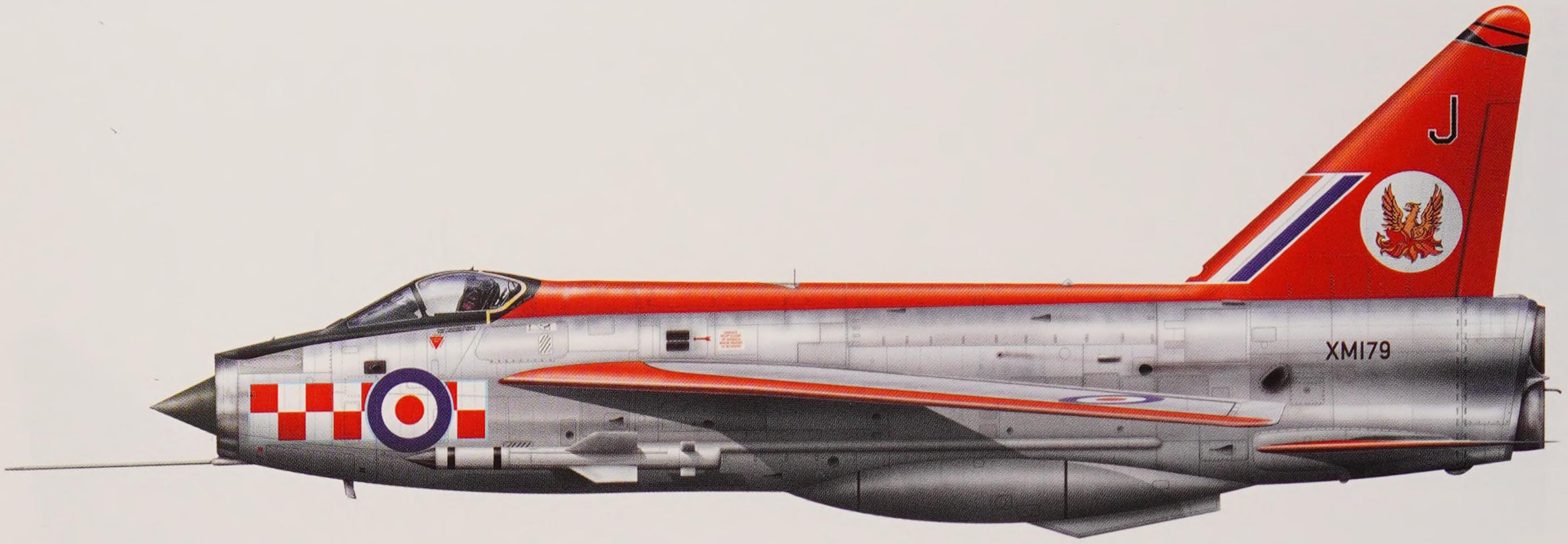
LIGHTNING F.2, XN783, 92 Squadron 1963

C/N 95136 ff D. de Villiers 26.1.63. 92 Sqn (A) 26.3.63. To Warton 1.5.69 for conversion to F.2A standard. To 19 Sqn (G) 11.5.70. Final flight 11.1.77 with 2983 hours, to Bruggen. Airfield decoy allocated 8526M. Scrapped on site 1992.



LIGHTNING T.4, XL629, ETPS, 1970

C/N 95050 ff R.P. Beamont 29.9.59. Second prototype T.4. Retained by EE Warton for development and trials work. To A Sqn A&AEE 13.6.60 for T.4 preview assessment. Appeared at 1960 SBAC Farnborough show. To ETPS Farnborough 13.5.66. To Boscombe Down 20.12.67 (coded 23). To Warton 31.10.69. Chase aircraft for Jaguar programme. To ETPS 6.5.70. Last flight 3.11.65 with 1383.55 hours. Boscombe Down gate guard 11.11.75. Currently on plinth at gate.



LIGHTNING F.1A, XM179, 56 Squadron 1962

C/N 95066 ff D. de Villiers 4.1.61. 56 Sqn (F) 28.2.61. To Middleton St. George 12.12.61 for servicing training. To 56 Sqn 19.2.62, re-coded (J) 'Firebirds' team. Crashed near Wattisham 6.6.63 following collision with XM181. Pilot Mike Cooke ejected but injured. 353 hours.

overwing tanks providing a further 540 gal, would give the aircraft a much more respectable fuel capacity. It was also agreed that the CLE modification would be introduced, particularly because emphasis was now shifting towards the aircraft's combat-fuel rather than ferry fuel capacity. The CLE design was similar to that which had already been test flown on P.1A WG760. The precise dimensions of the design were dictated primarily by the need to avoid redesigning the leading edge fuel tank and the new cambered edge began at its outboard edge. It was test flown on F.Mk.2 XN725, which had already been assigned to trials of the overwing tanks. Additionally, XP697 was taken from the production line and refitted at Filton with the CLE wing, incorporating slightly reduced-span ailerons and new ventral tank with stabilising fins, before returning to Warton for a series of 50 test flights.

The aircraft then went to Boscombe Down where, following an evaluation, A&AEE concluded that, although longitudinal control had deteriorated slightly at high speeds, overall handling was satisfactory. XN725 and XN734 were assigned to test the overwing fuel tanks which were now to be adopted. Original interest in the tanks had disappeared when the Air Staff decided that the Lightning needed a longer supersonic flight time capability. This would have meant jettisoning the subsonic tanks before accelerating to supersonic speed. But with a much larger internal fuel capacity the overwing tanks would provide potential for a useful additional ferry flight capacity. To meet the 2,000 nautical mile ferry range requirement, the only other option would have been to develop an even larger 860 gal ventral tank. But as this would be only subsonic, it would require the smaller supersonic tanks to be transported overseas separately or pre-stocked wherever required. Consequently, the overwing tanks appeared to offer the best solution to the RAF's needs. But when flight testing began it soon became clear that the tanks would only extend the aircraft's range by around 100 nm rather than the expected 300 nm. This was because the tanks were fitted with cumbersome vertical and horizontal fins necessary to cleanly separate them from the wing when jettisoned. Now it had been established that the tanks would only be used for ferry purposes, they would be partially or completely emptied if jettisoning was ever found necessary. Fuel was dumped in the event of an emergency landing. This meant that the fins were no longer necessary and were subsequently removed, thereby restoring their range improvement to 300 nm.

English Electric was keen to offer a variety of other improvements based on the larger ventral tank. These included the possibility of fitting two Aden cannon to the forward portion – an option which was later revived – a reconnaissance pack and even a drop-down rocket pack. Similarly, it would have been possible to fit additional weaponry to new underwing stores points or attached to the overwing tanks and even the wing tips. But official interest never materialised. The view persisted that the Lightning was simply an interim design and that only the most necessary and basic modifications should be incorporated into the design. Although noticeably different in external appearance, the redesigned aircraft were not significantly changed in terms of equipment or systems when compared to the basic F.Mk.3. Initially the modified aircraft were simply referred to as extended range Lightning Mk.3s before being re-designated Lightning F.Mk.6 (Interim) and finally the standard production Lightning Mk.6.

The first production examples (XR752-XR767) were taken from the F.Mk.3 production line and modified to interim standard. They were not equipped to carry the overwing tanks, although they were subsequently brought up to full F.6 standard in 1967-8. The first aircraft took to the air on 16 June 1965 before being delivered to the AFDS. In addition to this first batch of 16 aircraft, a further seven were completed to F.Mk.3 standard but placed in temporary storage before being converted to full F.Mk.6 standard before delivery. An order for a further 33 Mk.3 Lightnings, subsequently built as F.Mk.6 models, was placed in January 1964.

No.5 Squadron, formerly equipped with Javelins, took delivery of the first F.Mk.6s when XR755 and XR766 arrived at Binbrook in December 1965. The remaining aircraft were delivered over the next three months, joining the handful already operating from the base with the AFDS. Further deliveries enabled No.74 Squadron to exchange its existing F.3s for the new variant. The old aircraft were ferried south to Wattisham to re-equip No.29 Squadron. The first F.6 reached Leuchars on 1 August 1966 but it was December before the last F.3 was withdrawn. Intensive flying covered all aspects of the now almost standard training syllabus but particular emphasis was placed upon aerial refuelling, combined with routine carriage of the new overwing tanks.

This was in anticipation of the squadron's move to Singapore and the Lightnings made their long ferry flights in three waves during June 1967, supported by Victor tankers and Britannia transports. Once settled into their new base at Tengah, the aircraft became responsible for air defence of the region as part of FEAF. They replaced the last Javelins which could now go into retirement. The next F.6 deliveries, at Binbrook, allowed No.11 Squadron, another former Javelin unit, to re-equip with the type. The first (XS928) arrived on 4 April with the remainder being delivered over the next couple of months. This brought Binbrook up to full strength and began what was to be a long and happy association with the Lightning until its retirement from RAF service more than 20 years later.

It also marked the peak of the RAF's Lightning strength with two squadrons at Binbrook, two at Wattisham, two at Leuchars, two more at Gutersloh, plus the Akrotiri and Tengah units. The F.Mk.6 progressively replaced a substantial number of F.Mk.3s with each squadron, apart from No.29 which operated only the F.3. However, the reverse situation also applied, with some F.3s eventually going to Nos. 5 and 11 squadrons as the mix of aircraft variants between units slowly evened-out.

Well-known photograph of 'Firebirds' F.1A XM176 of 56 Squadron. Visible are the two pipes which injected diesel dye into the jet exhaust to produce white smoke during the team's formation display. (Photo: MoD)

Although the F.Mk.6 was essentially an extended-range F.Mk.3 derivative, it was undoubtedly the most versatile and useful variant. It was 1,100 lb heavier than the Mk.3 but could carry 3,100 lb more internal fuel and had the ability to carry overwing tanks. Performance was very similar to the F.3's but with the advantages of more internal and external fuel supply, plus the redesigned wing. It also possessed an endurance which, although still sometimes uncomfortably short, was markedly superior to that of earlier models.

Endurance aside, the F.6 offered few improvements over the preceding F.3. In fact, the only other significant improvement to be made shortly after the F.6 entered service was the incorporation of an airfield arrestor hook. This enabled the aircraft to engage RHAG (rotary hydraulic arrestor gear) if a brake failure occurred rather than relying on the more traditional runway-end barriers which tended to straddle the Lightning's fuselage and damage its spine and tail. Although only a one-shot system, which had to be repositioned on the ground, the hook was trial-fitted during 1967 and subsequently became standard equipment for all second-generation Lightning variants.

It was not until 1970 that a more fundamental F.6 improvement was instigated when most existing aircraft were retrofitted with a pair of 30mm Aden cannon in the forward section of the ventral tank. With hindsight, it is clear that this modification should have been part of the original build as proposed by English Electric. But it was decreed that there was no need for gun armament on the F.Mk.3 and this was carried over to the F.Mk.6. Clearly, the addition of cannon came at the expense of some fuel capacity, although the ultimate reduction in range was only around 50 nm. But with the option of two Firestreaks or two Red Tops, and the addition of two 30mm cannon, the F.6 pilot had a much more versatile fighter at his disposal. This enabled him to pursue an attack after firing missiles if necessary. It also provided the capability to return fire if attacked without having to fall back by more than a mile to set up a missile attack and give the enemy pilot ample warning of his intentions.

Even though the Lightning was now regarded as an all-weather fighter, its missile armament could not function in bad weather because the infrared seeker was incapable of acquiring a target in cloud or heavy rain. Initial plans for a four-cannon fit were dropped in favour of just two as a weight compromise to preserve the aircraft's radius of action. Precisely why the Lightning's cannon armament was ever removed is still unclear. It seems likely that, as with so many other aspects of the Lightning's history, there was an almost blind faith in the capability of missiles. With the cannon restored the Lightning earned a reputation as an effective and stable gun platform in contrast with the Phantom whose pod-mounted gun was considered less accurate than the Lightning it replaced in RAF service.

Yet the Lightning was still short of armament, especially when compared with other contemporary fighter designs. In most combat scenarios the two missiles would be launched simultaneously to maximise the chances of a kill. This meant that before the cannon refit the Lightning was essentially a one-shot interceptor. As the aircraft aged, the meagre range of weapon options became increasingly embarrassing. But considering that the Lightning was, for a quarter of a century, regarded as being on the verge of withdrawal, the lack of will to invest in any armament improvements does not seem quite so ludicrous and the logic of the many short-term 'austere' improvements is easier to understand. Harder to comprehend, though, is why the government and Air Staff were incapable of accepting the Lightning's potential and why it was steadfastly believed that something better was just around the corner.

While the production of F.Mk.3 and F.Mk.6 aircraft was in progress, consideration was being given to improving the earlier F.Mk.2 which went into regular squadron service in Germany. From the outset it had been accepted that these aircraft should eventually be made more compatible with the later F.3 and F.6 force, although it was agreed that they would still be incapable of carrying the overwing tanks available to the F.6 squadrons. The reasoning was that because the commitments to Germany were regarded as being separate to the Lightning's other UK and overseas operations, those assigned to Germany would not be available for other overseas deployments requiring the longer range ferry fuel capacity. However, the relatively large area of the ADIZ (air defence identification zone) in Germany was substantial. It was, therefore, felt necessary to fit the new 560 gal ventral tank to the F.2 fleet.

Initially, it was also intended to equip the F.2 with Red Top capability. This plan was later dropped and the aircraft was to remain only compatible with the Firestreak. But having already been equipped with two Aden 30mm cannon and with the option of a further two in the lower nose section, albeit

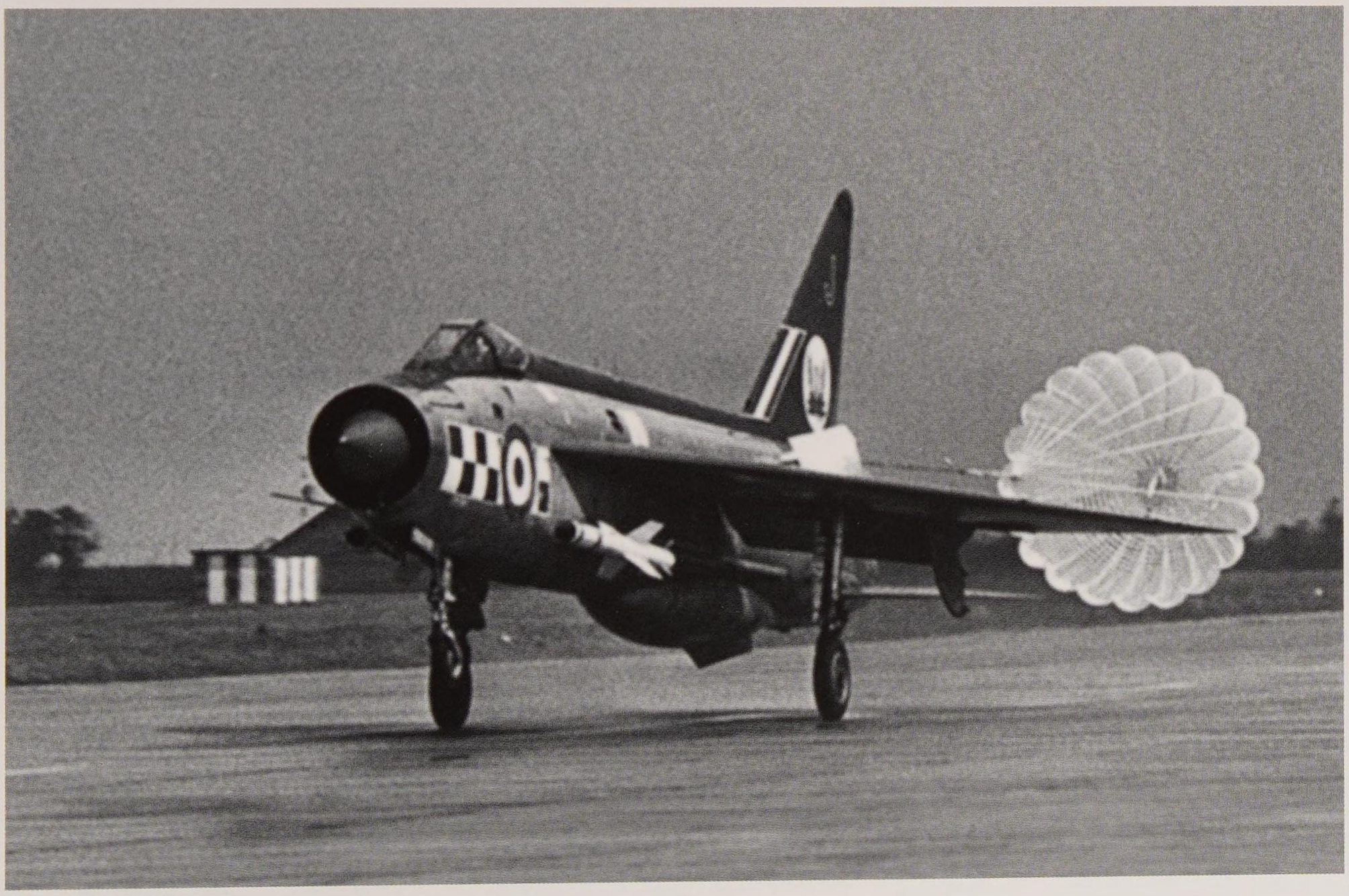
F.Mk.2A XN728 streaking skywards over Gutersloh. Pictured during the early 1970s the aircraft was repainted in green camouflage during 1974. Sadly, after being retired in 1977, the aircraft languished at Coningsby as an airfield decoy before being transported to a scrapyard close to the A1 near Newark, where the aircraft has gradually succumbed to the attention of souvenir hunters and vandals. (Photo: Dick Lohuis collection)

Pictured on approach to RAF Luqa, T.5 XS421 wears the markings of No.111 Squadron, plus the application of a Luftwaffe unit 'zap' on the nose. After retirement from RAF service the airframe (minus other wings and fin) was transferred to the P&EE at Shoeburyness, for FOD ingestion research. (Photo: Richard Caruana)

Magnificent view of XS933 streaking in across the runway threshold at Luqa with a familiar Maltese background. Fighter Command's Lightning squadrons were regular visitors to Luqa and No.56 Squadron were particularly common visitors, making the relatively short 'hop' from their base in Cyprus. (Photo: Richard Caruana)

F.Mk.6 XR758 wearing semi-completed 5 Squadron markings at Binbrook. Manufactured as an Interim F.6 the aircraft was modified to full F.6 standard in 1967. After serving with No.74 Squadron in Singapore, the aircraft was returned to Warton in a Belfast freighter after suffering a starter explosion whilst on detachment at Darwin during September 1969. (Photo: Terry Senior)

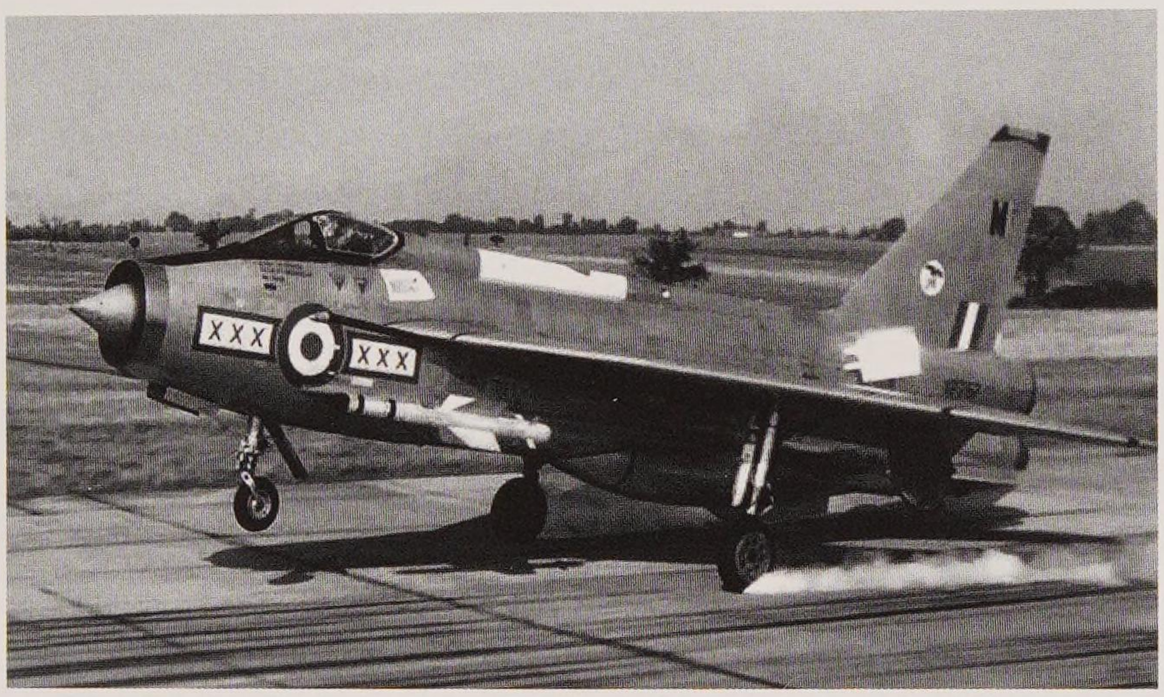
Unusual view of XR728 low over the North Sea in 1988 shortly before retirement, illustrating the deep, slab-sided nature of the fuselage and the subtle contours of the wing's leading edge. (Photo: Tim McLelland)



F.Mk.1A XM179 touching down at Wattisham, brake 'chute fully deployed. Sadly the aircraft was destroyed during a 'Firebirds' practice flight in June 1963 after suffering a collision with XM181. Although pilot Mike Cooke ejected, the seat malfunctioned and he was seriously injured. (Photo: Tim McLelland collection)

LIGHTNING F.3, XP757/F, 29 Squadron 1968

C/N 95185 ff T.M.S. Ferguson 4.7.64. 23 Sqn (G) 25.9.64. To 60 MU 20.9.67. On loan to MoT A Sqn A&AEE 13.12.67. To 29 Sqn (F) 15.2.68. To 60 MU 19.6.70. To 29 Sqn (M) 17.3.71. To 60 MU 9.1.75. SOC 13.11.75 with 2083 hours. Sold to J. Shackleton as scrap, removed 12.75. Components to Darren Swinn, Boston.



Lightning F.3, XP757, as in above colour profile, is captured here as it makes a landing at Wattisham circa 1971. This photograph shows the aircraft's 'second tour' with 29 Squadron, as it now carries the individual aircraft letter 'M'. In her initial time with the squadron in 1968 she carried the letter 'F'. (Photo: Tim McLelland collection)

at the expense of missile capability, the improved F.2 (designated F.Mk.2A) would still be a flexible fighter. During 1962 it was agreed that 31 aircraft should be modified to F.2A standard. This was based on the assumption that both squadrons would each operate 12 aircraft rather than the current 16, which reflected their additional commitment to the defence of the Berlin corridors. The fate of the ten unconverted aircraft was to be decided at a later date. By 1963 the Air Staff said they should be held in storage pending their possible use in extending the life of the existing Lightning fleet post-1972 as no replacement aircraft had yet been identified.

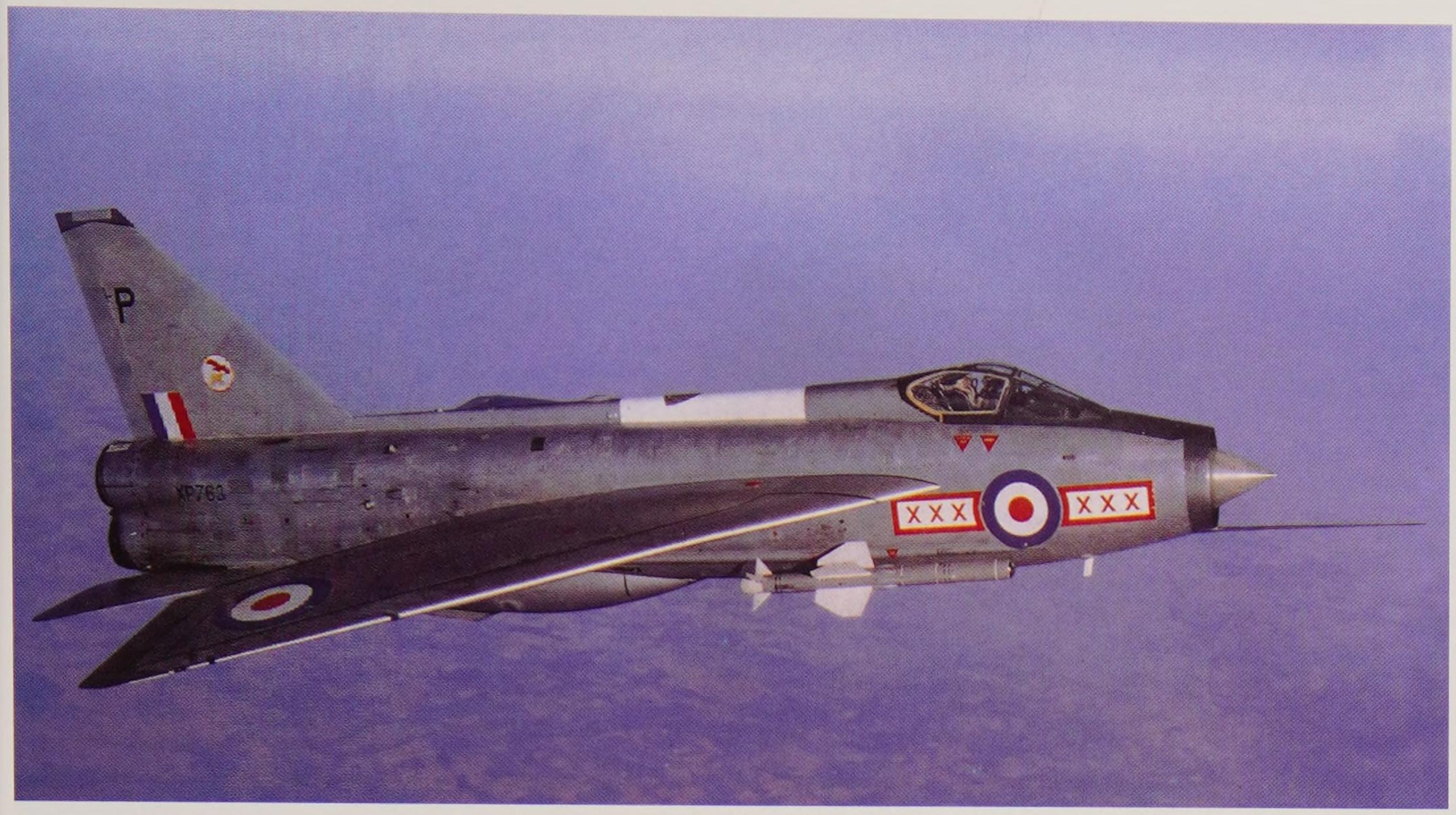
This was the first acknowledgement that the Lightning would probably be around for much longer than originally had been anticipated. Although the F.2A would incorporate the larger ventral tank and larger F.3-style fin, there was no immediate plan to fit the CLE wing. Flight tests performed with XN975 revealed that, although overall performance and handling was inferior to that of the extended range F.3, the F.6, it was felt to be adequate for service use. Perhaps rather unusually, the Air Staff decided that the CLE should be fitted to achieve a great degree of commonality with the rest of the Lightning fleet and give the aircraft the additional performance. This decision may well have been influenced by the fact that the F.2A's engines would remain unchanged, albeit with some minor modifications, and would therefore be less powerful than those fitted to the later second generation Lightnings. Other improvements included a strengthened shock cone enabling the aircraft to operate routinely at speeds in excess of Mach.2.0, an arrestor hook and improved brakes.

The first completed conversion to re-enter service was XN789, which arrived at Gutersloh on 15 January 1968. By February 1970 both Gutersloh squadrons had re-equipped with the F.2A, although a few unmodified F.2s remained in use for some considerable time even after the last F.2A conversion (XN774) arrived at Gutersloh in September 1970. Of the 31-aircraft order, XN975 was never fully completed to F.2A standard, while three other F.2s (XN725, XN734 and XN795) were all effectively partially-converted Lightnings completed to different standards as part of the variant's test programme. Even though the F.2A was undoubtedly inferior to the later F.6 in terms of overall performance, it was a particularly popular aircraft with pilots. They appreciated its cannon and its surprisingly good range. The F.2A's Avon 211Rs required fewer drag-creating vents and intakes along the fuselage and pilots claimed unrefuelled endurance at high level of up to two hours.

Running parallel to the main Lightning design and production programme, resources were allocated to creating a two-seater to act as a conversion trainer. Although the first new Lightning pilots had been obliged to progress straight from the Hunter or Javelin into the Lightning's cockpit, such a situation could only apply to very experienced pilots. A two-seat derivative was anticipated from the outset in much the same way as the Vampire, Meteor and Hunter had been developed. The aircraft, given the company designation P.11, would enable instructors to teach each new Lightning student the intricacies of transonic control, trim control, instrument flying – particularly in rapid climbs – and weapons training.

The Air Staff first outlined their requirements in 1954, stating that the trainer should be available before the production P.1 went into squadron service. The usual delays resulting from budgetary over-prudence prevented this from happening but the Air Staff was always clear that the trainer's development should not delay production of the single-seat P.1. Once the requirement was established it was also agreed that the trainer should differ as little as possible from its single-seat counterpart and retain similar performance and handling qualities. In essence this meant that it should be designed to the same specifications as the single-seater but with a revised nose section to accommodate two pilots. After much research and study, and careful examination of the merits of a tandem arrangement, English Electric proposed that the trainer should feature side-by-side seating. In fact, the company's interest in the tandem layout had largely been so that an operational trainer could be developed as an aircraft which could still perform the same operational tasks as its single-seat counterpart.

The tandem layout would also enable the aircraft to retain the single-seater's supersonic performance and manoeuvrability but wind tunnel tests revealed that it would degrade directional stability to the extent that even a significantly enlarged fin would not be sufficient. A side-by-side arrangement



XP763 spent two years with No.23 Squadron prior to joining No.29 Squadron, the unit with which the aircraft remained in service until April 1974 when it was withdrawn after having flown 2089 hours. (Photo: MoD)

was, therefore, chosen almost by default, although it was recognised that the arrangement actually improved directional stability. The design resulted in a new nose section forward of the wing leading edge. Across the lower fuselage it was identical to the F.1, but it bulged outwards towards the upper fuselage to incorporate a wider cockpit, windscreen and canopy. Behind the bulged cockpit area, a new, wider spine fairing extended along the fuselage, tapering to the F.1's proportions at the base of the fin. The same windscreen and canopy layout was adopted but effectively doubled in width. From the perspective of both instructor and student the all-round view was slightly better than in the single seater.

Cannon armament was deleted but the same missile fit of two Firestreaks was incorporated. With the same wings, engine and tail, the T.Mk.4 was essentially a minimal-change twin-seat version of the F.Mk.2. Although the wider nose section gave the impression that performance would suffer as a result of additional aerodynamic drag, tests proved that the performance differences were very small, thanks largely to area ruling which the larger cockpit section created. Time to Mach 0.9 at 36,000 ft was predicted to be only 6 sec longer, for example. Yet despite identifying the need for a trainer variant and instructing English Electric to proceed with its design, and having specifically stated that it should enter service ahead of the single-seater, it was not until July 1958 that a contract for 30 aircraft was finally placed.

After the 1957 Defence Review the trainer programme appears to have been ignored for some considerable time. The thinking behind the order was somewhat confused, having been based on a requirement for 44 aircraft. The Ministry of Supply raised this to 50 but then accepted authority for only 30. After placing the contract the figure was further reduced to just 20. From this figure two aircraft would later be withdrawn for conversion to the later T.Mk.5 standard, the trainer equivalent of the F.Mk.3.

The first T.Mk.4 (XL628) was completed in 1959, making its first flight on 6 May in the hands of Roland Beamont who reported on its excellent handling qualities. The aircraft was initially equipped with only one seat for the test pilot and no oxygen system was provided for the right-hand seat position. But after a series of early flight tests the aircraft was withdrawn for installation of the additional seat. Once fitted, it was hardly surprising that English Electric's Freddie Page wanted to take advantage of the opportunity to fly in his creation. Beamont invited fellow test pilot Johnny Squier to accompany him on a short flight to check out the new seat before entrusting the safety of the company's managing director to it. Squier's association with the T.4 was to prove somewhat colourful. It had been known for a while that some of the instrument wiring had been incorrectly routed so that an intermittent fuel pressure warning light for number two engine actually referred to number one and *vice versa*. On one particular day the engine was already showing troublesome symptoms even before take-off. Squier considered abandoning the sortie but eventually decided to go ahead. Things progressed relatively smoothly for a few minutes until, at 25,000 ft, the aircraft began to shudder violently. The oil pressure light was illuminated but Squire forgot that this was mis-routed to the other engine and instinctively shut down the good engine, number one. In a matter of seconds he found himself at Mach 1.3 without any engine power. After declaring an emergency and heading back to Warton, he managed to re-start number one engine and presumably regretted the common practice of test flying with minor accepted faults.

Things became even more dramatic for Squier when he flew XL628 again on

Compare your workaday week with Douglas Aylward's week

HE IS A MACH 2 PILOT IN THE R.A.F.

Douglas Aylward comes from Darlington, and went to Durham School. He had planned a career as a vet, but, attracted by the adventure and challenge of flying, he applied to join the Royal Air Force and was accepted. That was in December, 1961.
Now he's one of the new breed of fighter pilots, trained and fully 'operational', flying Lightnings at 1,500 miles an hour.
His Squadron, No. 92, is stationed at Leconfield in Yorkshire. It has three main responsibilities.
The first of these is anti-intruder—a cold war role: this means that the Squadron must at all times have the ability to intercept and identify any apparent intrusion into our air space—by day or by night, and irrespective of weather.
The Squadron's second role is oversea reinforcement: it must be ready to serve abroad at a moment's notice. Last—but not least—is the fighter's historical task: the denial of British air space to enemy aircraft in war.
All these are, in their different ways, *preventive* functions. Flying Officer Aylward is part of the force that keeps the cold war cold.

Douglas Aylward is a typical R.A.F. pilot. Here are 5 typical days from his week.

MONDAY Interception training today, two Lightnings together, each practising on the other. As Lightnings could approach each other at speeds of up to a mile a second, radio control from ground is essential. Exercise starts 0830—briefing with other pilot to agree exercise procedures. 0930, take-off, and climb to 36,000 ft. On first run act as target, hear controller directing other Lightning in 'attack' . . . then hear attacker say he is in radar contact, can carry on by himself. Proves this by simulating missile attack, afterwards closing to gun range. For second run, change places and repeat manoeuvre from different angle. Then third run, then fourth; then land. Coffee in crew room. 1145, take-off for Visident (Visual Identification) exercise: interception as previous, but close in to minimum range and stay at that. Afternoon on 'secondary duties'—sorting out sports fixtures; afterwards studying film of the morning's exercises.

TUESDAY Morning, low-level interception—same principle as high-level, but much trickier radar-wise. Afternoon, 'probing and drouging'—practise taking on fuel in flight from tanker aircraft—essential training for oversea reinforcement.

WEDNESDAY On standby for 'QRA'—Quick Reaction Alert: wear full flying kit, must be ready for immediate scramble. Stay either in crew room or Ops room. Spend time brushing up aircraft recognition until 1300, when new QRA crew takes over. After lunch in the Mess, station rugger match.

THURSDAY Night flying. First sortie at 1700, a series of high-level interceptions at various angles, the night-time version of Monday morning's exercises. Second sortie, night navigation exercise—Navex: a carefully pre-planned 'point-to-point' to exercise your role of pilot-cum-navigator (Lightning Mk. 2 is single-seater, one man has to do both jobs). Performance is always recorded—you can check up on yourself, see how your flight plan worked out.

FRIDAY After night-flying, the rule is: sleep in. Fly in the afternoon—one of three aircraft practising in close 'Vic' formation, held steady at precise half-wingspan distance. As No. 2 aircraft, occupy starboard position. Leader, in front, in continuous R/T control, orders whole series of 'wingovers'—one of the basic aerobatics, one of the best: part loop and part roll—so you come out going opposite direction, but right way up. Wingover follows wingover follows wingover—each smooth, exact perfectly under control. Spectacular to look at? Probably. Feeling of achievement, from complex job well done? Yes, certainly. But something else, too. Because all this is *evidence*—of how much a human being can develop, change and establish himself in three short years . . . flying, in the R.A.F.

Flying Officer Douglas Aylward's commission in the R.A.F. takes him initially to the age of 38. There is a good chance of selection for a full career until at least 55. Meanwhile, there is a significant and absolutely satisfying job of work to do, a good life in the best of company, and pay (at 23) over £1,000 a year. Think about this, and ask yourself: in challenge, in interest, in work that is really worth doing—what other profession offers you so much?

The Royal Air Force

If you have a good G.C.E.

If you are between 17 and 26 with G.C.E. at 'A' or 'O' level or equivalent *(minimum: 5 acceptable 'O' levels including English language and mathematics), and can satisfy a Selection Board that you have the right qualities of intelligence, aptitude, and leadership potential . . . think: in a matter of weeks you could be in the R.A.F., and a whole new way of life would lie before you.
*Grade I passes in the new Certificate of Secondary Education are acceptable in lieu of 'O' level passes.

Talk to the officer in charge of your nearest R.A.F. Careers Information Centre, or fill in this coupon now, and post it today. To Group Captain J. W. Allan, D.S.O., D.F.C., A.F.C., R.A.F., Adastral House (GR 217), London, WC1.
Please send me details of flying commissions in the Royal Air Force and a free copy of the booklet 'Flying and You'.

NAME _____
ADDRESS _____
_____
DATE OF BIRTH _____
Please attach a separate sheet of paper giving details of G.C.E. and other educational qualifications you hold, or expect to gain.

105

Recruitment advertisement from 1965, extolling the virtues of being a 'Mach 2' pilot in the RAF – and the aircraft to achieve this experience in was none other than the Lightning, the RAF's most powerful fighter to date.

1 October. As part of the test programme he had been tasked with flying it up to the extremes of inertia coupling following on from a similar sortie earlier in the day when Beamont had performed tests at up to Mach 1.6. Like many of these test flights, the standard route was flown. While making a high-speed run towards St. Bees Head he radioed Warton to confirm his pull-up towards 40,000 ft but after a couple of additional transmissions to Fighter Command control at Killard Point, contact with the aircraft was lost. Radar returns indicated that the aircraft had crashed into the Irish Sea west of Whitehaven. XL628 had indeed crashed. The test flight had continued at 40,000 ft and Squier had put the aircraft into a roll at Mach 1.7. There was then a catastrophic loss of control, accompanied by what Squier later described as a loud 'crump.' The aircraft yawed violently, flicked inverted and yawed in the opposite direction. Squier concluded that the tail fin had been torn off. There was no time even to radio a Mayday call and he promptly ejected. Although Squier survived the incident and a whole day in the Irish Sea, it effectively ended his association with the Lightning as a solo test pilot.

Recovery of wreckage enabled investigators to conclude that the tail fin had indeed failed under the stresses of the high speed yaw. The Air Ministry, however, took a different view. After conducting its own investigation it concluded that the primary cause was probably the inadvertent selection of the undercarriage. Squier insisted this had not happened. Subsequent analysis confirmed the undercarriage theory was incorrect and that the fin had simply failed under extreme load. This prompted English Electric to make immediate modifications to the structural strength of all Lightning F.1, F.1A and T.4 aircraft being produced at the time.

This accident showed there was still more to learn about the effects of inertia coupling and the problem recurred later during the trials programme with similarly catastrophic results. The much-delayed T.4 programme would have been delayed still further had it not been for the second aircraft (XL629) which had already made its first flight on 29 September. This aircraft was largely responsible for completing the test and acceptance programme, undertaking most of the test flights which would have been shared with XL628. After completing most of the trials work, strain gauges were fitted to the fin and instrumentation was installed so that the precise structural limits, exceeded by XL628, could be investigated. On one of these flights XL629 revisited a problem which had first manifested itself during the early P.1 programme: the loss of the aircraft's canopy. It opened and became detached during take-off from Warton at around 100 knots due to misplaced locking links and a failed indicator light. This prompted English Electric to install duplicate warning lights and a revised hinge catch design.

The test flights continued and eventually the aircraft was flown up to Mach 1.7, at which stage 180-degree rolls were performed with entry acceleration varying between 1g and 4g. The trials confirmed that the T.4 could be cleared to the same rolling limits as the F.1, although structural limits were approached more closely at subsonic speeds and low altitudes. Manufactured in parallel with the F.Mk.2, the first T.Mk.4 off the production line was XM966, which made its first flight on 15 July 1960. With just 60 hours of test flying to its credit, the aircraft was then delivered to Filton for conversion to T.Mk.5 standard. The next to be completed should have been XM967 but it was withdrawn before completion and transported by road to Filton where it subsequently became the T.Mk.5 prototype. The first production T.4 destined for RAF service was therefore XM968, which made its first flight on 9 November. This particular aircraft did not enter service until 1966, having first been assigned to further trials, including armament and runway performance work. It was later assigned to the TSR2 programme at Boscombe Down where the Lightning's sprightly performance enabled it to act as chase aircraft. The two-seat T.4 finally entered RAF service with the Lightning Conversion Squadron at Middleton St. George in 1962, the first example arriving on 27 June.

Two T.Mk.4s were destined to become prototypes for the T.Mk.5 before they were even built, such was the rapid progression from first to second-generation Lightnings. The T.Mk.5 was intended as a two-seat variant of the Mk.3 which would retain all the single-seater's systems and equipment but have a revised cockpit section to accommodate two crew members. Similarly, the aircraft offered similar performance to the F.Mk.3. They could carry both Firestreaks and Red Tops and lacked any gun armament. A contract was placed on 25 November 1960 for a batch of 20 and English Electric – now BAC and already committed to a heavy manufacturing programme – outsourced the production of the new forward fuselages to Bristol Aircraft at Filton. The initial contract covered only the production of materials and further piecemeal additions to the process continued until 23 August 1962 when final authority to construct the aircraft was given.

The prototype T.5 first flew from Filton on 29 March 1962 piloted by Jimmy Dell who ferried it back to Warton the following day. This aircraft had a unique electrical starting system which required external plug-in equipment and which in retrospect might have been more suitable for the entire Lightning fleet rather than the troublesome Avpin unit which had been imposed on English Electric by the Air Staff and MoS. In addition to the new forward fuselage – identical to that of the T.Mk.4 – the T.5 also incorporated the F.3's larger tail fin, strengthened undercarriage and brakes and cockpit instrumentation.

The cockpit layout was markedly different to the T.Mk.4's, not least because the design staff had difficulty in finding sufficient space for the additional and larger throttle box and radar controller for the right-hand seat.

XN787 was manufactured as an F.2, subsequently modified to F.2A standard late in 1969. In 1974 the aircraft's bright bare metal finish was replaced by dark green camouflage. (Photo: Paul Tomlin)

Lightning F.6 XS923/BE seen up-close over the North Sea. As can be seen, by the time this photograph was taken (just a few weeks before retirement) the Lightning's sleek lines have been slightly marred by many years of use, resulting in patched paintwork and worn panels. Even the fibreglass nose cone shows obvious signs of wear and tear. (Photo: Tim McLelland)

In the T.Mk.4 the throttle box had simply been duplicated in the usual position to the immediate left of the right-hand seat and placed on the centre pedestal. But for the T.5 the design staff proposed to move the box to the right-hand cockpit wall, which meant that the instructor would be obliged to use his right hand to control the throttle and his left to hold the control column, a strange and potentially dangerous arrangement. Of course nobody could be certain whether the concept would work and an A&AEE test pilot set up a series of trial flights with a twin-seat Hunter, sitting in the left-hand seat so that he could fly the sorties with his right hand on the centre-pedestal throttle and left on the control column. He reported that the set-up seemed strange at first but after five sorties, which included aerobatics and instrument approaches, he concluded that handling the aircraft with the controls in the reversed position was perfectly acceptable. As a result the T.Mk.5's controls were constructed to this layout. The idea was always the subject of great debate throughout the Lightning's service life and, although some pilots believed that the concept was almost ridiculous, no accidents were ever attributed to the unusual controls layout.

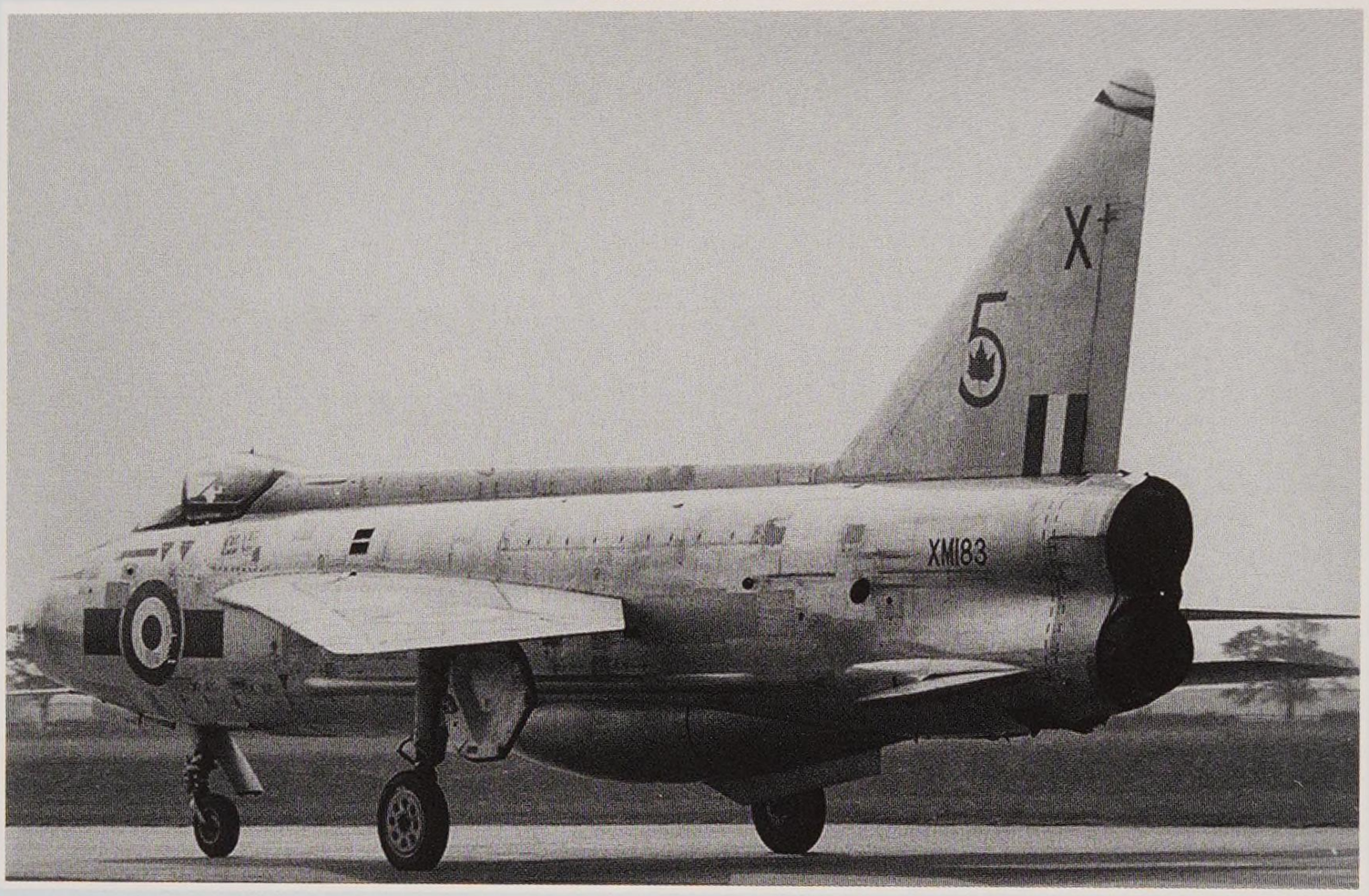
The T.Mk.5 test programme proceeded well until 22 July 1965 when XM966, the second to join the trials, was destroyed in a catastrophic incident in which there were echoes of the problems afflicting the prototype T.4. The same rolling trials were being undertaken over the same test route but this time with the addition of the extendable 2 in rocket launcher pack which had been proposed for the aircraft. During a roll at Mach 1.8 pulling 3g at 35,000 ft, Jimmy Dell lost control and subsequently reported hearing a distinct bang, reminiscent of the earlier incident. The nose flicked to port and the aircraft rolled over inverted, at which stage the observer, Graham Elkington, ejected. Dell elected to stay with the aircraft and managed to make a Mayday call before deciding to abandon it. Both occupants survived the incident and investigation suggested that the same catastrophic structural failure had occurred under almost the same conditions. This was a serious situation for BAC and the Air Ministry. Some T.4s were already in RAF service by this stage and an immediate modification programme was implemented to further strengthen the stage three fin. BAC accepted that the stress effects of roll and yaw coupling were still not fully understood. Once these improvements had been incorporated, the T.5 was considered fully flight-worthy and as history records, went on to train countless Lightning students for the next two decades.

As with the single-seaters, the T.Mk.5 could have been developed into a much more capable aircraft with official support. As it was, plans were made to incorporate the 600 gal ventral tank and CLE wing as fitted to the F.6 but eventually the cost of these modifications was judged to be too high. Likewise, an even more ambitious plan was devised to manufacture an operational variant of the two-seater which would have become the F.Mk.5 with a two-man crew. This had happened with the Javelin and it was proposed to build 70 aircraft to equip five squadrons.

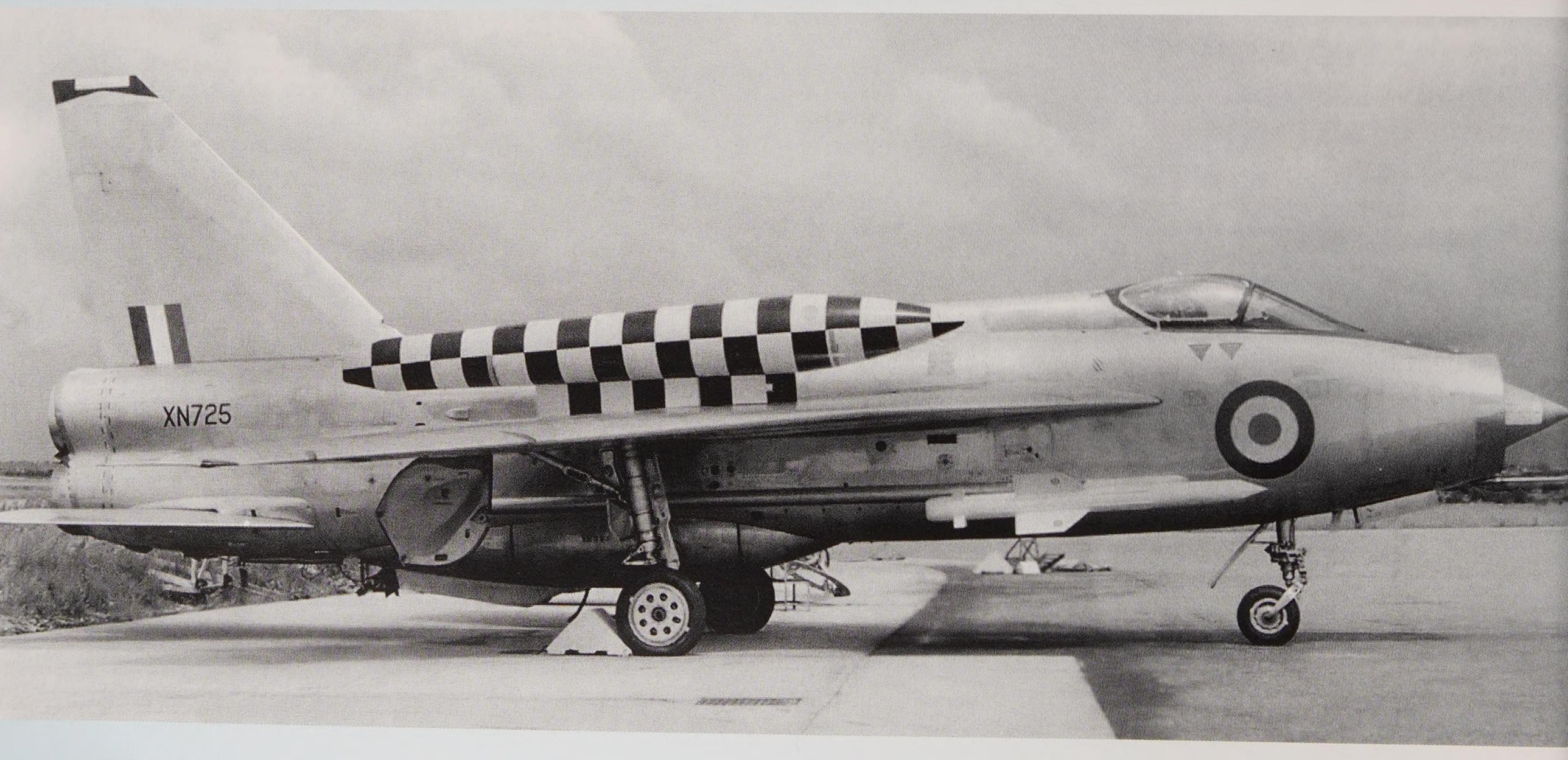
Like so many ideas conceived during the Lightning's design and developmental stage, the concept was considered too expensive. But although the Lightning's development was undoubtedly restricted to the most necessary and affordable improvements, there is no doubt that the British taxpayer received value for money. At the time of its entry into service there was nothing to match the Lightning.

F.2 XN787 posing for the camera shortly after delivery to No.19 Squadron at Leconfield. The aircraft was later converted to F.2A standard and acquired a large F.6-style ventral tank and cambered wing leading edges. (Photo: MoD)

XM183 was one of only a handful of Lightning F.1As operated by No.5 Squadron. A former 'Firebirds' team aircraft, it was used by 5 Squadron as a lightweight target facilities aircraft during the early 1970s. (Photo: Terry Senior)

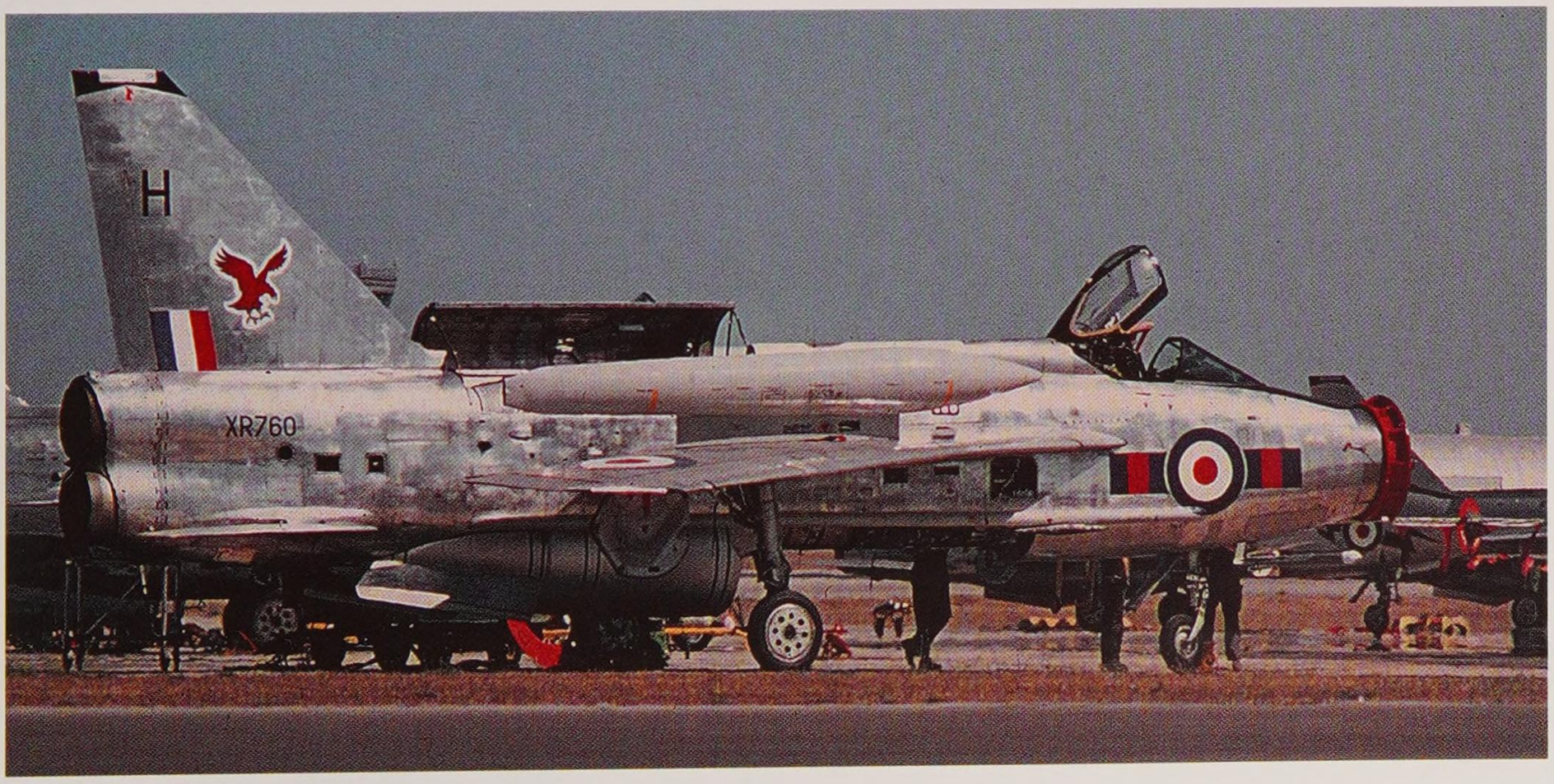


Below: Modified F.Mk.2 XN725 was used to conduct arrestor hook trials at Warton which subsequently led to the introduction of 'one shot' (ie non-retractable) hooks to the Lightning fleet. The overwing tanks were painted in order to provide a useful photographic reference feature for test cameras. (Photo: British Aerospace)



Busy scene at Luqa as XR724 is towed into the huge 'Shackleton' hangar during a deployment from Leuchars. When fitted on aircraft during the 1970s, the overwing tanks were inevitably painted white or Light Aircraft Grey. (Photo: Richard Caruana)

XR713 spent much of her early service life with No.111 Squadron before being relocated to Binbrook. Pictured during a visit to Luqa, the aircraft also carries a small Luftwaffe 'zap' on her nose. The aircraft is still with 111 Squadron, albeit as a static exhibit at Leuchars. (Photo: Dick Lohuis collection)



Engine runs in the baking heat at Luqa, XR760's bare metal glistening under the Maltese sun. A couple of years later the aircraft succumbed to the camouflage programme and joined No.5 Squadron at Binbrook. (Photo: Richard Caruana)

A former member of the 74 Squadron display team at the 1962 Farnborough show, XM139 was also used as a solo display aircraft during the early 1970s, suitably adorned with a Union Flag as illustrated. (Photo: Paul Tomlin)

One can almost hear the rumble of Avons and smell the warm kerosene as the mighty Firebirds team taxies out to perform a practice display at Wattisham. (Photo: MoD)

A typical scene at Akrotiri with the resident Lightnings of No.56 Squadron sharing ramp space with five visiting Phantoms from No.31 Squadron based at Bruggen. (Photo: MoD)

A suitably posed RAF PR photograph of No.56 Squadron's flight line at Wattisham, during the 'Firebirds' display season. Pitot tube covers and tags were important safety measures as both air and ground crew were notoriously liable to walk into the probe causing damage to both it and themselves! (Photo: MoD)

Breathtaking view of the 'Firebirds' in action over Wattisham, the three rear aircraft trailing white smoke. (Photo: MoD)

Below: XR716 at the 1974 IAT at Greenham Common. This particular aircraft returned to display flying for the 1987 display season and flew the Lightning F.3's very last aerobatic sequence during September of that year. (Photo: Glenn Sands collection)

XR770 after having had her bright red trim removed and having transferred to No.11 Squadron. (Photo: Terry Senior)

After returning from Akrotiri complete with pink trim and flamingo motif, XS452 was repainted dark green as part of Binbrook's camouflage trials which eventually led to the 'standard' grey/green scheme used through the late 'Seventies onwards. A second aircraft (XS458) trialled the equivalent grey scheme.
(Photo: Dick Lohuis collection)

Two 19 Squadron F.2As on the runway at Gutersloh, about to be airborne. XN731 was withdrawn from flying duties in December 1976 after having achieved an impressive 2845 flying hours. (Photo: Paul Tomlin)

F.Mk.3 XR713 heading to Luqa's runway during an exercise deployment to Malta. Of interest is the deflected one-piece tailplane unit which was rarely seen outside of the neutral horizontal position when the aircraft was on the ground. (Photo: Richard Caruana)

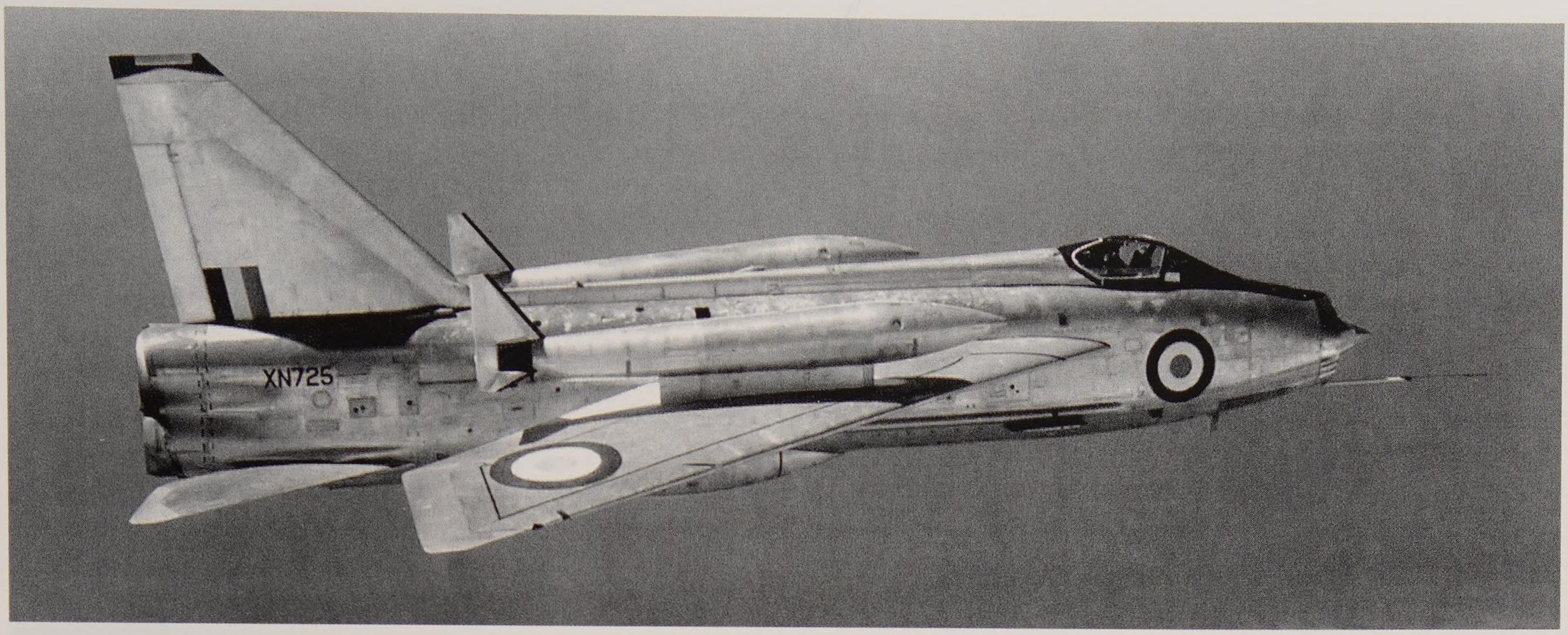
XR723 was manufactured as an F.Mk.3 but after completion the aircraft was stored at Warton and converted to F.Mk.6 standard. Pictured at Binbrook in 1977, the ventral gun bay door can be seen partially open and the gun muzzle deflector rings (a later F.6 modification) are also visible. Two years after this photograph was taken the aircraft crashed into the sea off Akrotiri following an engine fire. (Photo: Dick Lohuis collection)

An interesting photograph which contradicts the notion that Lightnings were always parked with airbrakes retracted. Although a rare sight, the brakes could be opened if ground access was required.
(Photo: Terry Senior)

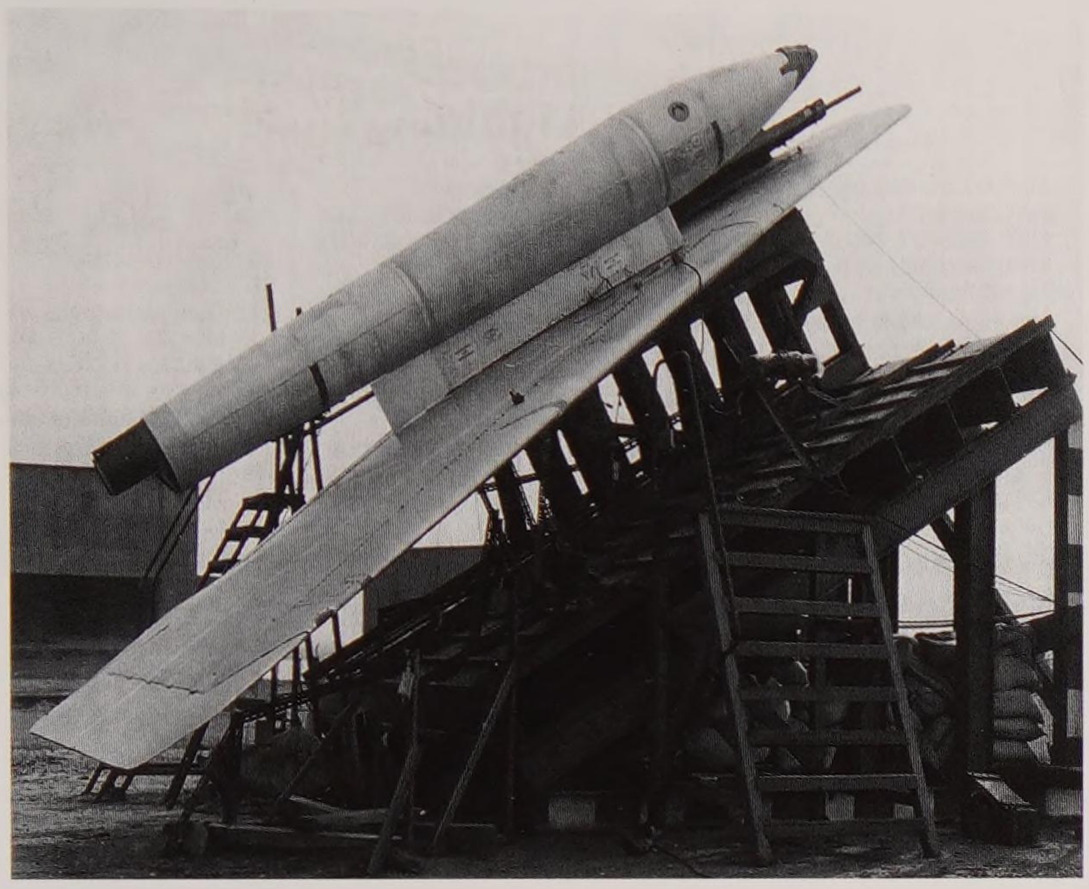
Above: A typical scene which would no doubt bring back some less than happy memories for former Lightning engineers. XR756 is pictured undergoing servicing at Binbrook and illustrates that gaining access to the aircraft's internal structure was never easy. Of interest are the soot-covered engine exhaust cans in the foreground. (Photo: MoD)

T.5 XS416 pictured during an exercise deployment to RAF Luqa. One of the last operational Lightnings to be repainted in camouflage, the aircraft remained unpainted until June 1977. (Photo: Dick Lohuis collection)

XS458 pictured during a spell of service with No.5 Squadron in 1979. The fin-less Red Top missile is probably a radar acquisition round. (Photo: Terry Senior)



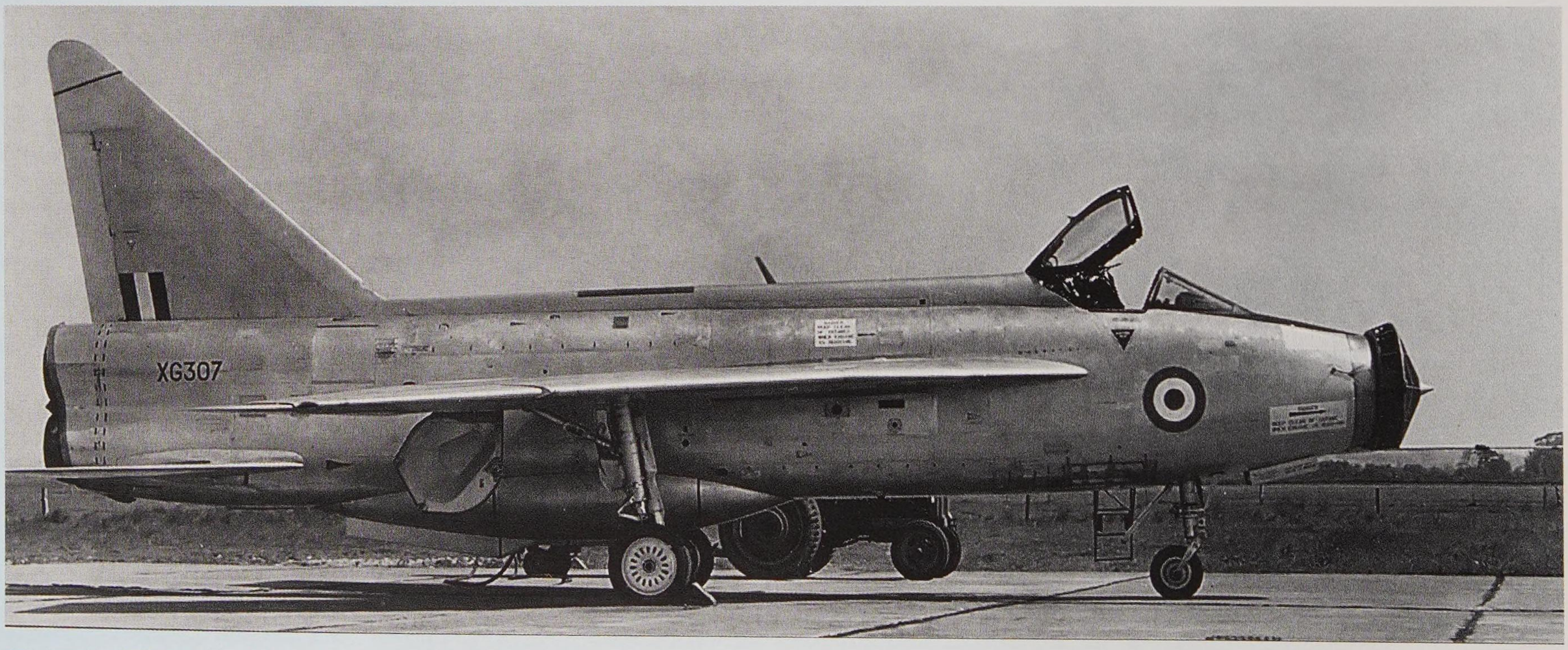
XN725 during flight trials with overwing tanks, these being fitted with stabilising fins at this stage (designed to enable the tanks to safely clear the aircraft when jettisoned). The fins were later abandoned and XN725 was refitted with cambered wing leading edges. (Photo: British Aerospace)



Jettison trials for the Lightning's overwing tank were conducted at Warton during March 1965 using a ground rig. (Photos: British Aerospace)

XS927 pictured at Tengah whilst serving with No.74 Squadron. This picture provides a good illustration of the F.6's 'cranked' wing leading edge. (Photo: MoD)

Excellent bird's-eye view of XS898, illustrating the wing walkway demarcation lines, and the matt black anti-glare trim which extends around the wind shield and down to the intake lip. (Photo: MoD)



DB aircraft XG307 was the first P.1 to be completed at the Samlesbury factory. Pictured at Boulton Paul's Seighford factory whilst being fitted with F.3 development equipment, the aircraft has already been retrofitted with the larger Stage Two tail fin. (Photo: British Aerospace)

Chapter Four

LIGHTNING FLYING

TRACING the history of the Lightning's development is a fascinating journey through a stage in the history of the Royal Air Force when the potential of the jet aircraft was first truly realised.

The day-to-day activities of the various Lightning units would be enough to fill the pages of many books such was the breadth and variety of missions performed by the aircraft. But to offer a glimpse into the world of Lightning operations there can be no substitute for the direct experience of those who flew and worked on the aircraft. Peter Collins first encountered the Lightning at the very beginning of its long RAF career. He says: 'When people ask me what was the best aircraft I ever flew it has to be the Lightning. It was in the Autumn of 1959 that I was transferred from the All-Weather Development Squadron of the Central Fighter Establishment to the Air Fighting Development Squadron to form part of the small team of pilots tasked to evaluate the Lightning for Fighter Command. We had the manufacturer's Pilots Notes prepared by English Electric and there was a rudimentary cockpit simulator under development at Aylesbury to which we had access but only instrumentation, no visual or motion simulation. This proved to be of little value. It was absurdly sensitive and left us feeling slightly apprehensive about what lay ahead. We needn't have worried. In late December the first of our six development batch [DB] Lightnings was delivered to Coltishall and we could experience the real thing.

'Wg Cdr Jimmy Dell, our boss, had been Fighter Command liaison officer with English Electric at Warton and was closely involved with the development flying. There was no two-seater, of course, but we were all experienced fighter pilots and had been well briefed by Jimmy. Even so that first flight was a revelation. The rate of climb was fantastic, even in cold power. The Hunter chase aircraft, used to observe the early flights, took off first, under GCI control and in radio contact. It climbed to about 8,000 ft over the airfield as we started to roll, and was invariably passed in the climb at about 15,000 ft. Even at that early stage you could tell that this was going to be a real pilot's aeroplane and a delight to fly. It was light and responsive to the controls, the pent-up acceleration was enormous and the turn-rate was impressive.

'All too soon – usually around 45 minutes after a climb to around 36,000 ft – the rapidly decreasing fuel state dictated a return to earth and the first circuit and landing had to be accomplished. This was not too demanding. Circuit speeds were not too different from the Hunter – undercarriage down at 230 knots, 175 knots round finals and across the hedge at 155 knots. Touchdown on the 360 psi tyres was quite firm and streaming the drag `chute soon controlled the landing run, reducing speed for a safe turn-off and return to dispersal. It was altogether exhilarating and introduced me to some of the best flying of my service career.

'The Lightning was not only the RAF's first genuinely supersonic fighter, it was also our first single-seat radar-equipped fighter so the pilot had not only to fly the aircraft but to operate the radar and control the interception profile. Investigating the radar aspects of Lightning operation was my part of the evaluation. This was not a simple exercise. The radar system was the Ferranti Airpass, RAF designation AI 23. According to the brochure, all the pilot had to do was acquire the target, lock on and then follow the aiming dot of the pilot attack sight. However, this failed to allow for a number of operational realities. First, the Lightning, tracking out from the defended area, was likely to find its target heading in on a reciprocal course. The

XS422 high over Wiltshire shortly before retirement from the ETPS. In addition to the striking red trim, the aircraft also carries an unusual instrumented pitot boom and (unlike RAF T.5s) does not carry a refuelling probe. (Photo MoD PE)

F.Mk.6 XS898 is pictured during 1973 in the markings of No.5 Squadron whilst on an exercise in Malta. The small dayglow marking on the tail is a Maltese Cross emblem, applied by RAF Luqa VAS crews. (Photo: Dick Lohuis collection)

Lightning was armed with Firestreak, a pursuit course weapon which would have to be launched from behind the target. The aiming dot, on the other hand, would continuously point the fighter towards the target, making a Firestreak acquisition impossible. Secondly, the targets were likely to be equipped with radar warning receivers and would initiate jamming and evasive manoeuvres as soon as they detected an AI 23 lock-on.

'We therefore had to develop a procedure which would allow us to approach the target in radar search mode and manoeuvre into its stern cone by interpreting the radar search picture. These techniques were refined over the years and proved very effective but they imposed a considerable workload on the pilot. It was on AFDS that I had the closest shave of my flying career. We had lost a Lightning early in the trial when an undercarriage malfunction caused Ron Harding to bale out. It was not permitted to attempt to land the Lightning without all three wheels locked down. Some time after this incident I was completing a night sortie when similar problems occurred. All my efforts to persuade the wheels to lock down – yawing, rolling, positive and negative g – were unsuccessful. There was very little fuel remaining. I was flying on one engine so if the other had run out of fuel the controls would have seized. I climbed up and prepared to eject. As I was about to go one of the legs locked down and I turned back towards base hoping that one good thing would lead to another. My faith was justified and I soon had three greens but no dive brakes or flaps and virtually no fuel. Nevertheless I completed a GCA approach and shut down at the end of the runway with the fuel gauges reading 25 lbs on one side and zero on the other! That sortie had included a supersonic interception and would normally have been completed in no more than 50 minutes. I logged 1hr 10 min!

'My next posting was to the RAF Handling Squadron at Boscombe Down where I was to be the fighter specialist, concentrating on producing the first aircrew manual for the Lightning. I had a good time there, flying a variety of different types, but in less than nine months I was promoted and sent to the Air Ministry for my first ground tour in 11 years. It was not until 1966 that I returned to Lightning flying as a flight commander on No. 23 Squadron at Leuchars. I soon found that Lightning operations had come on apace in the intervening years. Interception techniques were fully developed and the interceptor weapons instructor (IWI) was a key appointment in every squadron.

'Air combat was regularly practised and the Lightning's superb capability in the vertical plane together with its turning performance made it a formidable opponent for any of its fighter contemporaries. Flight refuelling was now an essential skill which I would quickly have to master and all these activities were regularly being performed by first tour pilots. No.23 Squadron was equipped with the Mk.3 Lightning which could carry the Red Top guided missile, giving it a forward hemisphere launch capability. But it had lost the guns, a deficiency which every true fighter pilot deplored. Before long, however, I was told that I was to re-form No.9 Squadron, one of the first to receive the Mk.6. With its much larger ventral tank and the capacity to carry overwing tanks, this variant at last began to address the Lightning's abiding weakness, its chronic shortage of fuel. An attempt had also been made to restore the guns with an optional pack which could be installed in the forward part of the ventral tank. I briefly commanded the squadron, having built it up from a piece of paper to a fully established unit ready to be declared to NATO. But it had recently been decreed that squadron commanders should be wing commanders and I had to hand over to David Blucke as soon as he'd completed the OCU course at Coltishall. I remained on the squadron strength as the senior flight commander.

'After a further ground tour at the newly-formed Strike Command I took command of my own squadron at last. It was Treble One of 'Black Arrows' fame and based at Wattisham. This was in July 1970 when the Lightning had been in service for ten years and there seemed little more that could be learned about it. These were probably the peak years of exploiting the Lightning's superb performance. It was the height of the Cold War. Everything had to be measured against the potential Soviet adversary, which was starting to introduce third generation supersonic aircraft into its inventory.

'An air defence matrix had been developed for the UK. The detection range of the ground radar stations was extended by the venerable AEW Shackletons, 20,000 rivets flying in relatively close formation. Meanwhile the Lightnings, with airborne tanker assistance, maintained combat air patrols for quite long periods at considerable ranges from the coast, using their own radars to augment the search pattern. In addition there was an impressive range of tactical techniques to be mastered. In a single month's flying we would cover subsonic P.Is at high and low level, supersonic interceptions, fighter-versus-fighter combat, visual idents by day and night, counter-ECM tactics, air-to-air refuelling and bomber affiliation. Added to these were air tests, instrument ratings, general handling checks, overseas deployments, occasional displays and flypasts, tactical evaluations and major air defence

When Binbrook's Lightnings started to adopt a grey 'air defence' camouflage scheme, XR770 was the first Lightning to emerge from St. Athan wearing the new two-tone colours. Initially, the national insignia were applied in low-visibility colours to the same dimensions as the 'high-viz' markings previously applied to bare metal aircraft. (Photo: Terry Senior)

Following the emergence of XR770 in new light grey camouflage, XS901 briefly appeared with correspondingly large national insignia, applied on the now-defunct grey/green camouflage. The purpose of this odd application is unknown but was probably due to insufficiently-specific regulations! (Photo: Terry Senior)

Even XR770's eye-catching red trim fails to brighten up another typically gloomy day at Binbrook. The aircraft was recently re-acquired by No.5 Squadron and has been transported to Waddington (where the unit currently operates Sentinel aircraft) as a display exhibit. (Photo: Terry Senior)

exercises. The single-seat Lightning pilot had to be a versatile and multi-skilled operator – and he was!

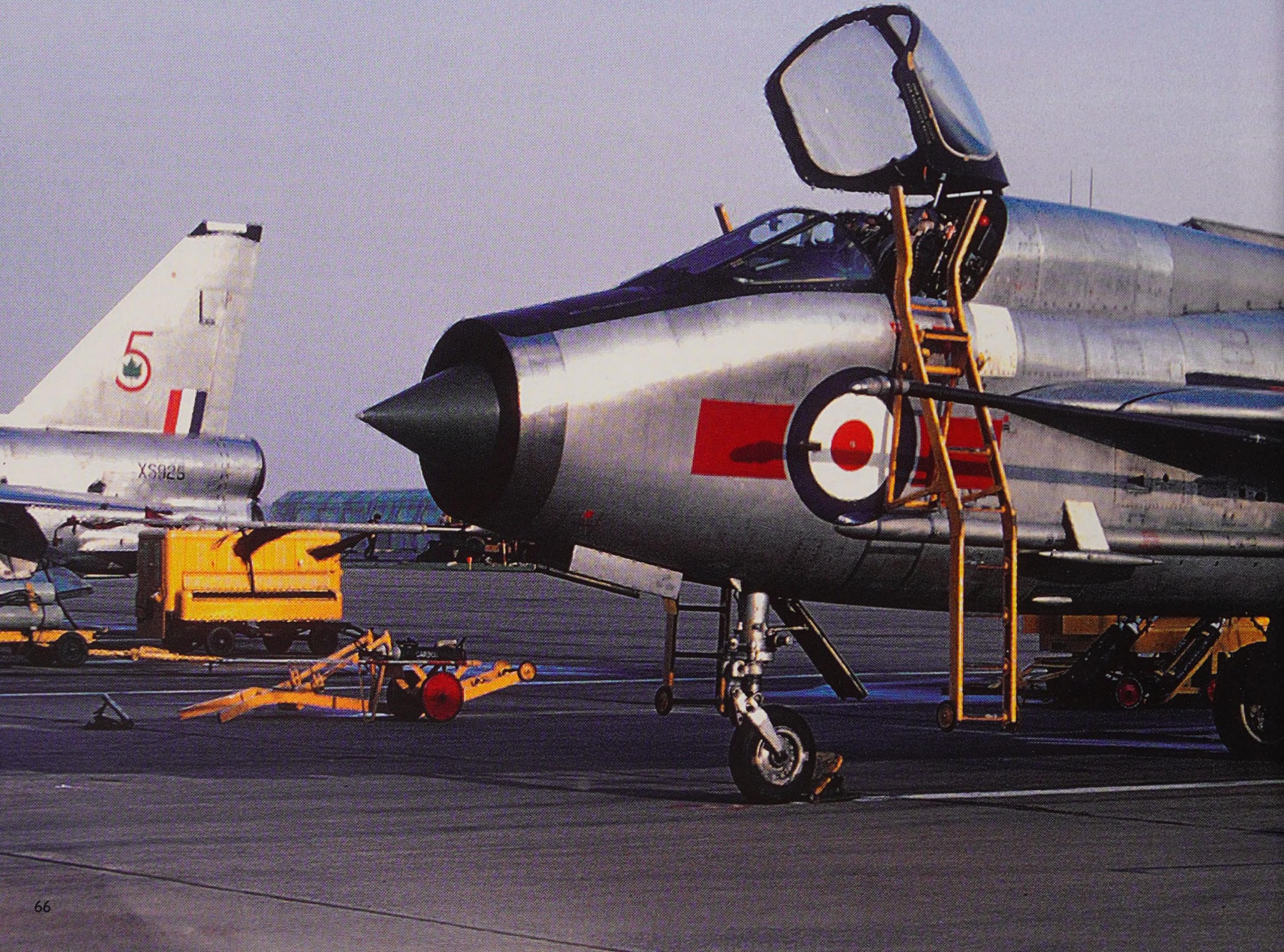
'Aircraft serviceability had always been a significant problem with the Lightning. In the early days on AFDS we'd been lucky to get as much as 20 sorties in a month out of each airframe. Over the years, this had obviously improved considerably as ground crew developed their expertise. But for me the turning point came when the Mk.3 squadron establishment was increased from 12 to 15 and the ground crew establishment rose proportionately. At the peak I had about 165 airmen on strength. This gave a depth of resource in the key trades which was crucial.

'In March 1971 we were able to achieve over 500 Lightning sorties and a total of 430 flying hours. This would have seemed inconceivable before. Fire was the principal cause of Lightning losses throughout its service life. This was partly due to the unusual engine layout with one directly above the other and to the inevitability of fuel leakage in the top engine dripping on to the hot jet pipe of the lower one. We were constantly required to install fire integrity modifications which placed a severe load on the station's engineering staff and took aircraft out of the line. In fact, during my two years in command of 111 Squadron not one of my aircraft was lost to fire, a fact which I attribute to the vigilance of my ground crew and the senior engineering officer's insistence on meticulous housekeeping methods.

'My final association with the Lightning at the active operational level came when I was appointed to command RAF Gutersloh in Germany where No.19 and No.92 were the resident Lightning squadrons. It should be remembered that the Lightning had been conceived as a high altitude, rapid climbing interceptor to defend the UK base. In Germany in the mid-1970s this was no longer a viable concept. The Soviets had recognised that NATO's radar cover and missile defences made high level airspace penetration a non-starter. They would inevitably come at low level, below the radar. The Lightning would have to be used in totally new ways, low down and over land where its monopulse radar would be of limited value. The Gutersloh squadrons had responded magnificently to this challenge having developed a matrix of low level patrol lines across the likely threat approaches. They had also devised a pairs technique of combined visual and radar scanning using the Lightning's massive acceleration potential and turning performance to complete the interception when a target was detected. Thus the Lightning was yet again demonstrating its exceptional versatility as a fighter which enabled it to maintain and extend its effectiveness over a remarkably long period. This was a fitting tribute to its forward-looking design and development so many years before.'

Sir John Severne also encountered the Lightning when the first-generation F.Mk.1 and F.Mk.1A variants were settling in to RAF service. No.226 Operational Conversion Unit was formed at Middleton St. George as a development from the early Lightning Conversion Squadron. He recalls: 'By the time I managed to pass the staff college qualifying exam I was getting a bit long in the tooth and was, by then, a wing commander. Consequently, I arrived at the RAF Staff College at Bracknell at the beginning of 1962 and found myself as the senior student. I managed to pass the staff course, but certainly not with any distinction, although this did not prevent me from landing the best job that I could have hoped for. I was to go to RAF Middleton St. George in Co Durham (now Durham Tees Valley Airport) as the Officer Commanding Flying Wing. The wing consisted of two flying units: the Fighter Command Instrument Training School flying the Javelin, and the Lightning Training Squadron. The Javelin had been in service since 1956 but the Lightning, our first supersonic fighter, was newer, having entered service with 74 Squadron in 1960.

'The Lightning represented a huge step forward from the Hunter and Javelin era and I greatly looked forward to getting to grips with this magnificent aircraft. But first, since I hadn't been flying operational aircraft for five years, I needed to do the one-month course at the School of Refresher Flying at RAF Strubby in Lincolnshire. We flew Meteor Mk.7s, the dual-control training version, and Mk.8s, the single-seat fighter variant. The Mk.8 had an ejection seat while the Mk.7 did not. Looking back I think I was fortunate not to run into trouble during my time instructing on the Mk.7 at



CFS because it would have been difficult to bale out of an aircraft at high speed without an ejection seat. It was good to get back to some serious flying but it took me a little time to regain my old form. I'd never flown a Javelin so the first thing I needed to do after completing the refresher course was to do the Javelin conversion course. This consisted of some 25 hr flying in the Mk.3 dual-control version. The Javelin was our first delta-wing fighter. It was a fine aircraft but needed to be treated with great respect because of the very high drag created if the angle of attack [the angle between the attitude of the aircraft and the direction in which it is flying] was allowed to become too high. Problems could arise, in particular, if you allowed the speed to get too low on the approach to landing, a problem aviators call 'getting on the wrong side of the drag curve.' Also, if the angle of attack was allowed to get too high the tailplane and elevators could become shielded from the clean airflow and that could cause all sorts of nasty problems.

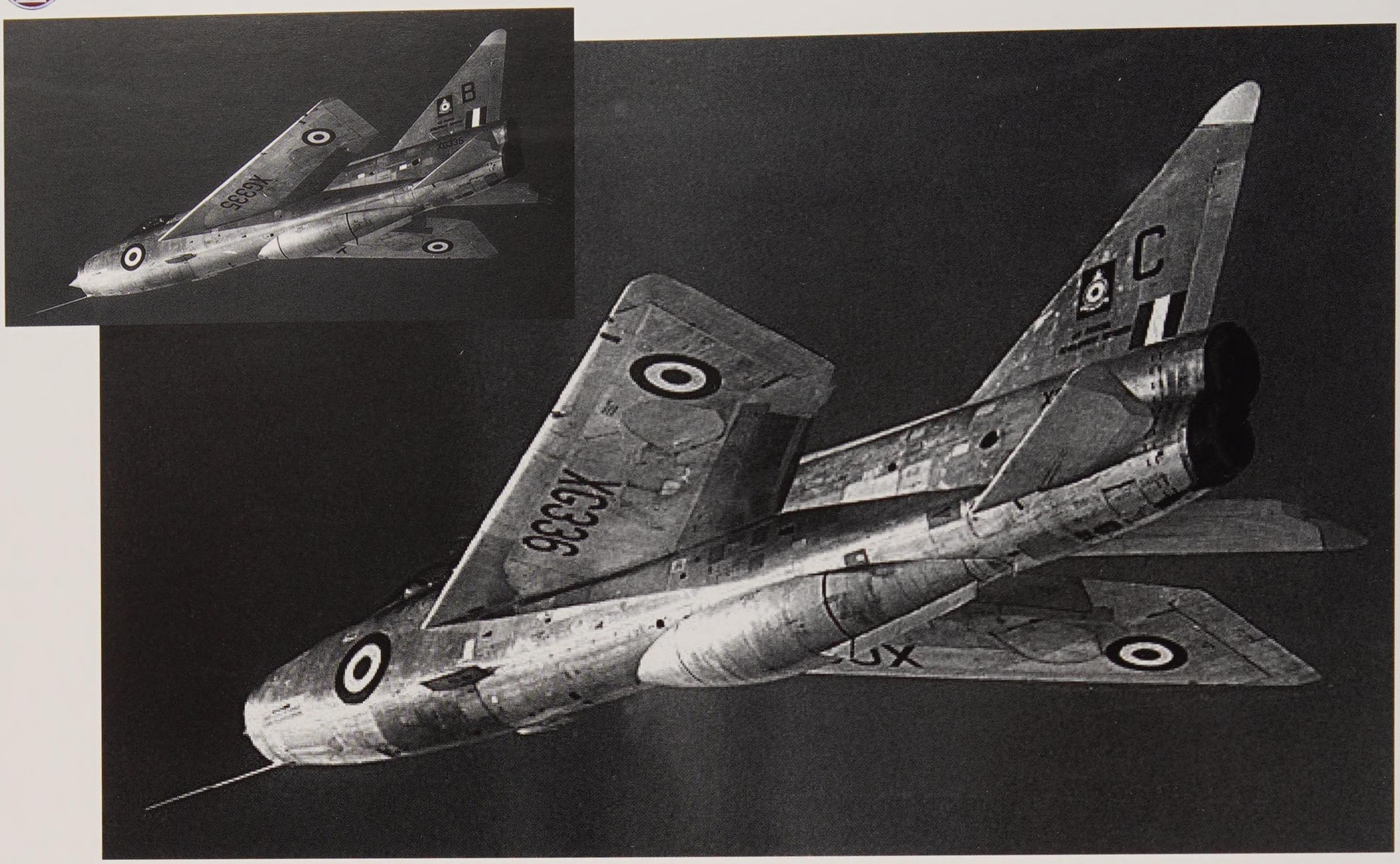
'The Lightning, by comparison, soon became one of my favourite aircraft. It was a delight to fly because, despite its stunning performance, it had few vices and most pilots had little problem in converting from lower performance aircraft like the Hunter and Gnat despite the higher workload. However, it was a different story for the ground crews. The aircraft was much more complex than any of its predecessors and it took some time for the engineers to get on top of it. It is the only twin-engined fighter to have one engine on top of the other and the very narrow fuselage left little room for the engineers to get at some of the problem areas that arose.

'The 65-degree swept wing was likely to result in a Lightning cartwheeling if the pilot attempted to land with one wheel stuck up. We were therefore told to eject rather than attempt such a landing. This policy was proved correct when an undercarriage leg collapsed on landing at another airfield shortly before I arrived. Although the aircraft was wrecked, it was astonishing that both pilots survived unhurt. The Lightning was designed for the Cold War era at a time when 'massive retaliation' using nuclear weapons was the preferred deterrence strategy. If any defence was possible under these circumstances, it centred on being able to knock down Soviet bombers before they could launch their weapons, some of which were of the stand-off variety. The Lightning was therefore optimised for rapid climb to height, acceleration to supersonic speed and then to destroy the bombers using air-to-air missiles in time to allow our nuclear forces, predominantly the Victors and Vulcans, to get airborne. This was deterrence in action: if the Soviets believed our nuclear forces couldn't be taken by surprise, then they'd think twice about attacking us.

'The aircraft designers obviously got it right because the time taken from releasing the brakes at the beginning of the take-off run to reaching the cruising altitude of 36,000 ft (nearly seven miles up) was exactly 90 sec. This was very exciting flying. But things were changing. Mutual assured destruction (the appropriately-termed MAD) looked increasingly futile and a period of 'flexible response' was emerging. This was recognition that a credible conventional defence backed by a range of nuclear weapons offered a more realistic strategy. Consequently, the Lightning was required to intercept at long range, as far as the Iceland Faroes Gap, and to deploy as far as the Middle East. And this it did very effectively using air-to-air refuelling, firstly with the Valiant and after that aircraft's demise, the Victor. This was later augmented by fitting the aircraft with a bigger ventral tank and over-wing tanks for deployment. It speaks well for the design that the Lightning seemed able to adapt to these changed requirements with few problems.

'The Lightning Conversion Squadron was commanded by Wng Cdr Ken Goodwin, himself a very experienced display pilot. He founded the 'Ten Ton

A relatively rare sight, T.5 XS451 is pictured at Binbrook minus her ventral fuel tank. Aircraft often made short post-servicing test flights in this configuration, never venturing very far from the airfield circuit for obvious reasons! (Photo: Paul Tomlin)



Pictured whilst in service with the AFDS at Coltishall, DB Batch aircraft XG335 (inset) and XG336 were both subsequently fitted with larger Stage Three tail fins and assigned to the Lightning F.3 development programme. XG336 was eventually allocated to the A&AEE and received a red-painted fin and spine. XG335 crashed during January 1965 whilst assigned to Red Top carriage trials at Boscombe Down. (Photo: MoD)

Club' with membership being confined to those who had flown 1,000 mph in a Lightning. Needless to say, there was a tremendous demand to be taken up in our two-seat aircraft and qualify for membership. When I was learning to fly the Lightning I found it more difficult to land than any previous aircraft I'd flown. I think the fact that it was a heavy aircraft which landed at about 150kts (about 170mph) meant that judging when to begin "rounding out" was critical. It took me about 20 hr before I could more or less guarantee to make a good landing, whereas I had achieved this much earlier in all previous aircraft I had flown. Incidentally, we were told in the ground school that the energy required to stop a Lightning on the runway was the equivalent of lifting an elephant up 500 ft and then cooking it!

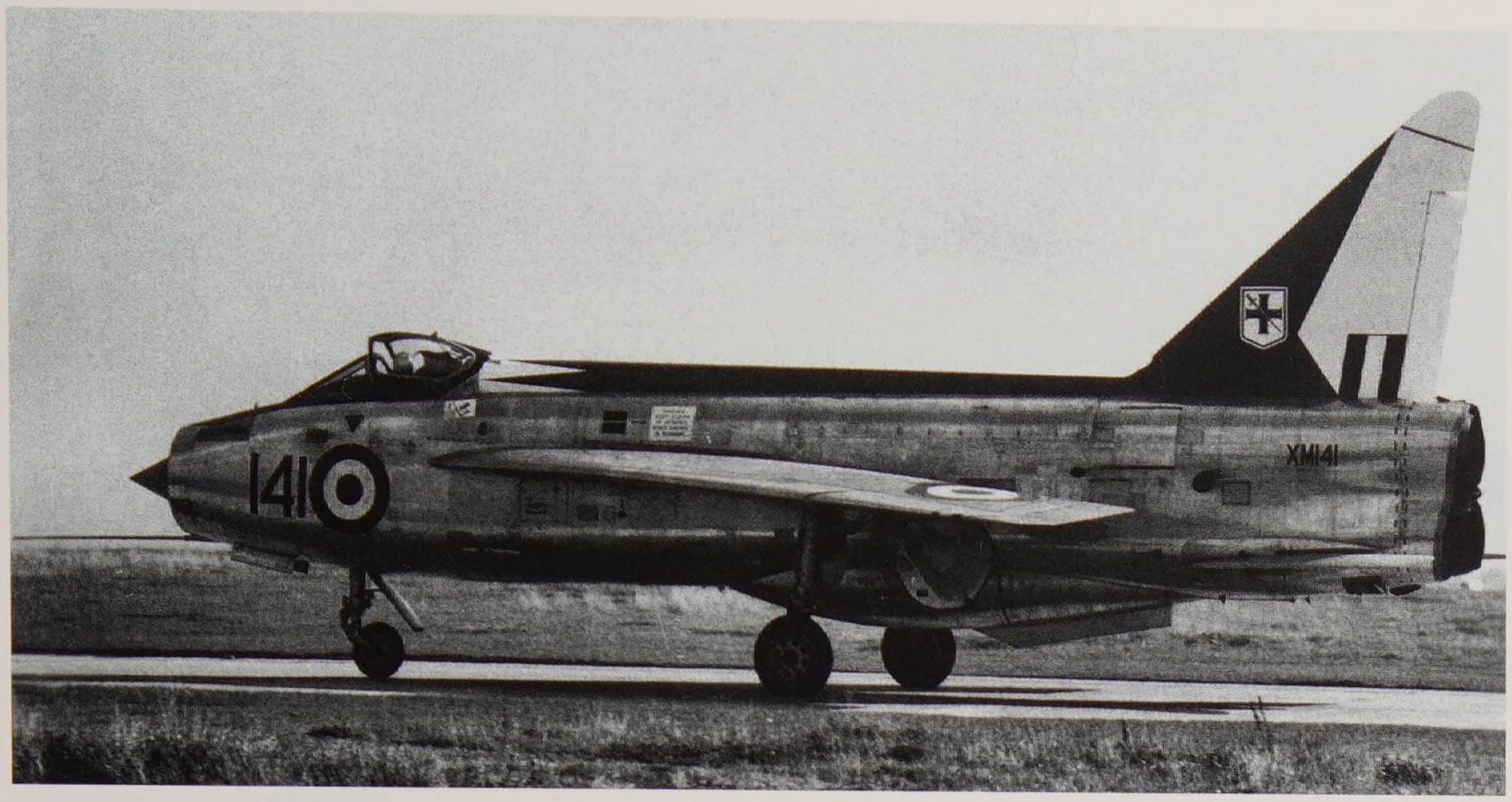
'It was also a difficult aircraft to operate as opposed to just flying it. Previous all-weather fighters, from the Mosquito through to the Javelin, had a navigator to operate the radar and to navigate. But the Lightning pilot had to do the navigator's job as well as his own. On the right-hand side of the instrument panel in the single seat aircraft was the radar screen which provided a host of information and included roll indications. The radar itself was operated by a hand controller which was equipped with a daunting number of switches and buttons on the left next to the throttles. Operating the radar with the left hand while flying the aircraft with the right could result in a very high work load. Naturally we Lightning pilots like to think that only the best people were selected to fly this magnificent machine. It's an interesting fact, however, that a remarkable number of very senior RAF appointments in the coming years seemed to have been held by former Lightning pilots.

'The squadron was equipped with the two-seat dual-controlled Mk.4 but six months after I arrived it expanded to become No. 226 Operational Conversion Unit. My appointment became chief instructor, which also encompassed the responsibilities of OC Flying Wing. Shortly after that we received additional Mk.1 single-seat versions. The OCU aircraft had a dramatic colour scheme designed by one of the instructors. The spine on top of the fuselage was red leading to a red flash on the leading edge of the fin. Also on the fin was the badge of our reserve wartime squadron, No. 145, depicting a sword and shield, and we called ourselves "The Crusaders." Training units flying operational aircraft have a wartime role, hence a reserve squadron number, in the same way that most servicemen in non-operational jobs have "war appointments" which they immediately take up on the outbreak of hostilities.

'With Middleton St. George being one of the stations which ran a Battle of Britain display each year, I was responsible as OC Flying Wing for organising the display and for its supervision on the day. We had a serious problem at Middleton St. George with a large roost of starlings in a wood just off the edge of the airfield, which was nearly in line with the runway. Birds can be bad news if you hit them, especially at high speed. A big one can do serious damage to the airframe. The engines can usually ingest a few small birds without too much damage but a large number of them going into the engine at the same time can put the bonfire out. When the starlings returned from their daily excursions, they flew in huge streams, some as long as half a mile, right through the approach path at about 150 ft.

'If a Lightning had flown through this stream it could well have suffered serious engine failure and might have crashed. We therefore had to stop flying for the half hour period when the birds were due home. The strange thing was that the starlings' departure procedure from the roost was quite different from their evening arrival. In the evening they flew home in dense streams from different directions, according to where they'd been feeding. In the morning they departed in a series of expanding concentric circles, like the ripples from a pebble thrown into a pond. We could see this clearly on the Air Traffic Control radar. The departure of the birds wasn't a problem because they weren't concentrated together. There are various conventional methods of persuading birds not to use airfields but none of those methods seemed to prevent our evening flow of starlings. So we took advice from an ornithologist who said we would have to remove the roost, but how? He said it was no use making a lot of noise once the birds had settled.

'They would just duck down and go to sleep. Similarly, we had no way of diverting the stream once it was on its way. The trick was to create one hell of a racket just as the birds were about to land, which they didn't like. We were told that it would probably take about a week before it had any effect but it was worth trying. If nothing had happened after a week they were probably never going to leave. We organised teams of volunteers armed with



Pictured at Middleton St. George whilst serving with 226 OCU, XM141 (an F.Mk.1) first served with No.74 Squadron and suffered a near-catastrophic accident on 16 May 1961 during a four-ship close-formation flight when the aircraft's rudder and part of the fin broke away. Investigations revealed that this had been due to aerodynamic disturbance caused by close formation flying, and led to a fleet-wide strengthening programme. (Photo: Tim McLelland collection)

such high-tech equipment as hammers and dustbin lids, Very pistols, thunderflashes, whistles and so on. We positioned vehicles with radios to spot the direction of the flow. The driver would then radio to the team by the wood so that they could rush round to meet the birds as they approached, waiting until they were about to land before creating the cacophony. Just imagine a bunch of grown men rushing around banging dustbin lids and letting off thunderflashes. It was great fun and much enjoyed by those of us taking part. However, all our efforts had no effect whatsoever for about a week and then, just as we had been told, one evening they never returned. Indeed they never came back at all. Success at last.

'We were able to see on the radar where they had gone. They had chosen a wood about ten miles away but we never let on to the new landlord where his 2 million starlings had come from. We now have starlings in our garden at home and to make up for my anti-social behaviour over 40 years ago, they're well fed and made very welcome.

'I should have realised that RAF Middleton St. George was due to close because a new electronics centre had recently been built there. It was quite remarkable how many stations closed soon after the completion of major building projects. Thus, on 13 April 1964 I led a formation of 226 OCU aircraft from Middleton St. George to RAF Coltishall in Norfolk. This was the famous Battle of Britain airfield where Douglas Bader had developed his "big wing" tactics. I was determined to arrive overhead at Coltishall in close formation exactly on time. Having planned to fly one of the single-seat Mk.1 aircraft, I'd previously flown the exact sortie in the simulator to help me with the navigation. This was a great help and I was pleased that on the day we were only 15 sec late. The following day I flew with our station commander, Gp Capt Roger Topp, in a Mk.4 Lightning. I was amazed at how well he flew the aircraft, bearing in mind that he hadn't flown for six months or so while Coltishall's runway was being resurfaced in preparation for our arrival. In retrospect I shouldn't have been surprised because this was the same Roger Topp who had looped those 22 Hunters at Farnborough. Furthermore, he'd been a test pilot at Boscombe Down helping to develop the Lightning.

'The Lightning course was divided into two phases, the first being the handling phase in which the student pilot learned how to handle the Lightning. The second was the more difficult one where he learned how to operate the radar and the weapons system. Most of the instructors were former Lightning squadron pilots and were experts as operators. I never achieved their level of proficiency but I used to carry out all the final handling checks at the end of the first phase of the course. Soon after our arrival at Coltishall it was decided that we would take first-tour students. These were students who, after receiving their wings flying Gnats at RAF Valley, were given 60 hr flying Hunters with 229 Operational Conversion Unit at RAF Chivenor before coming on to our Lightning OCU and joining an operational squadron on their first tour. Until then we had only accepted second tourists who were already experienced operational pilots, mostly from Hunter squadrons.

'There was much sucking of teeth from the old hands but I remembered that I'd been in much the same position when I started on the Mosquito. I had no prior operational or twin-engine experience yet had coped. Furthermore, I believed the young pilots would still be used to learning and I had no qualms at all about the new policy. The first four were those who'd been the best pilots at the Hunter OCU. I well remember flying with one of them on his final handling test because, to my delight and astonishment, he gave me a better ride than I had ever had from one of the instructors. The new policy was thus fully justified. My last day with the OCU at Coltishall was on 1 June 1965, the day of the AOC's annual inspection. The AOC was Air Commodore Al Deere, a famous New Zealand Battle of Britain pilot. My last flight was to lead 20 Lightnings in a fly-past for the AOC. Such fly-pasts usually consisted of all available aircraft flying by in close formation, but I wanted this one to be different.

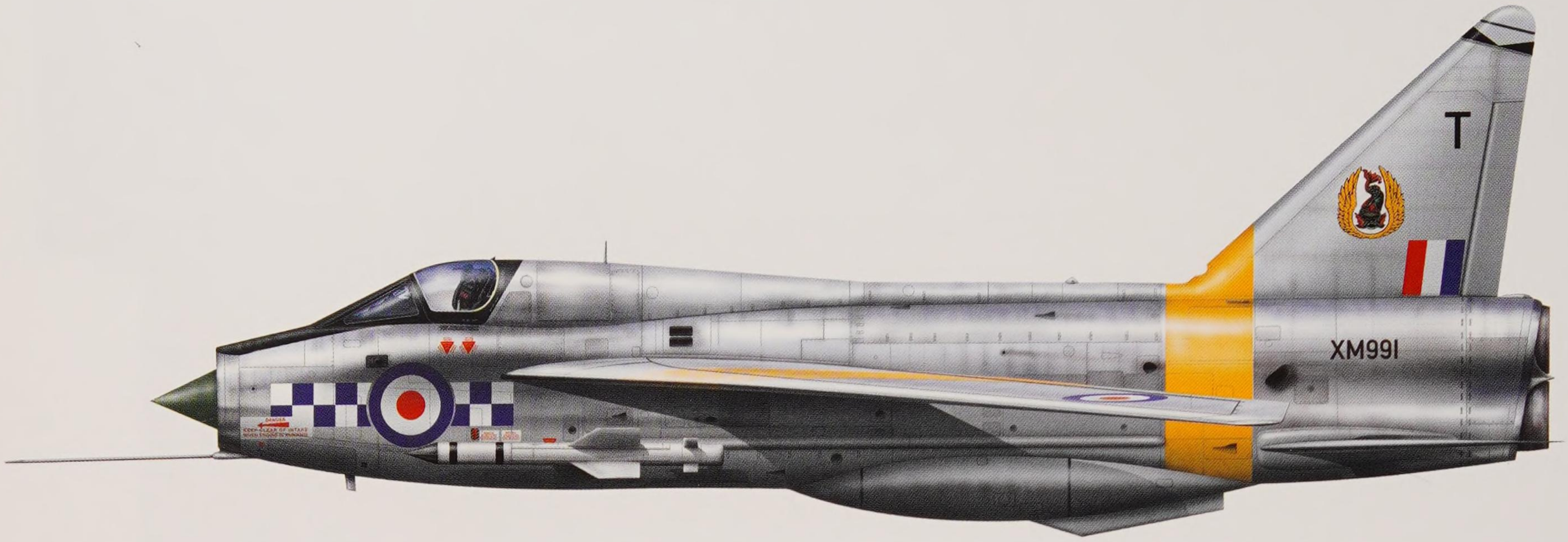
'We decided to take off at 10 sec intervals in reheat, thus making as much noise as possible, with the first aircraft returning overhead at high speed, still at 10 sec, just as the last aircraft left the ground. I would finally land the leading aircraft just as the last of the high-speed ones flew overhead. The idea was that, for 10 min there would be a non-stop stream of aircraft either taking off, flying by at high speed or landing. In the event I have to admit that by then the 10 sec interval had become a bit ragged. Anyhow, it was a wonderful way to bow out and I still look upon my Lightning days as among the very best in an interesting, exciting and thoroughly enjoyable flying career.

'The Lightning stayed in service until 15 April 1988 when I attended a guest night in the officers' mess at Binbrook entitled "The Last of the Lightnings." It was attended by a very distinguished gathering including the Chief of the Air Staff, Marshal of the Royal Air Force Sir Keith Williamson – himself a Lightning pilot I'd taught to fly when he was a Cranwell cadet – Roland Beamont, who first flew the prototype in 1954, and many of the squadron's commanders. The Lightning had been in service for 28 years, not bad for an aircraft originally expected to stay for only ten. It may have been light on fuel but it was immensely powerful and manoeuvrable and it was certainly a joy to fly.'

By contrast, Colin Wilcock's association with the Lightning came much later in the aircraft's history when the F.Mk.6 was established in service with No.5 Squadron at Binbrook. He later returned to the aircraft towards the end of its operational life, courtesy of the Empire Test Pilots School. His recollections provide a fascinating insight into the day-to-day life at Binbrook, the home of the Lightning:

'A day on No.5 Squadron in the years 1966-68 depended upon whether the squadron was holding QRA [quick reaction alert] or not. No.5 Squadron usually held the southern QRA commitment in rotation with the Wattisham squadrons, but we also held Northern QRA in rotation with the Leuchars squadrons. A typical day in 1967 when we weren't on QRA would start with the station met brief, which was attended by all aircrew including CFE [Central Fighter Establishment] and 85 Squadron which were also at Binbrook. The only exception was our early pair and their authoriser who would come in at 07:45 hr for an 08:30 hr launch.

'Met briefing lasted about 15 min, after which we all retired to our crew rooms for coffee. The burners of the first pair had to be selected at 08:30 hr promptly, otherwise there would be questions from the boss, Tony Winship. Very few excuses were acceptable. Our usual task was to carry out



LIGHTNING T.Mk.4, XM991, 19 Squadron 1963

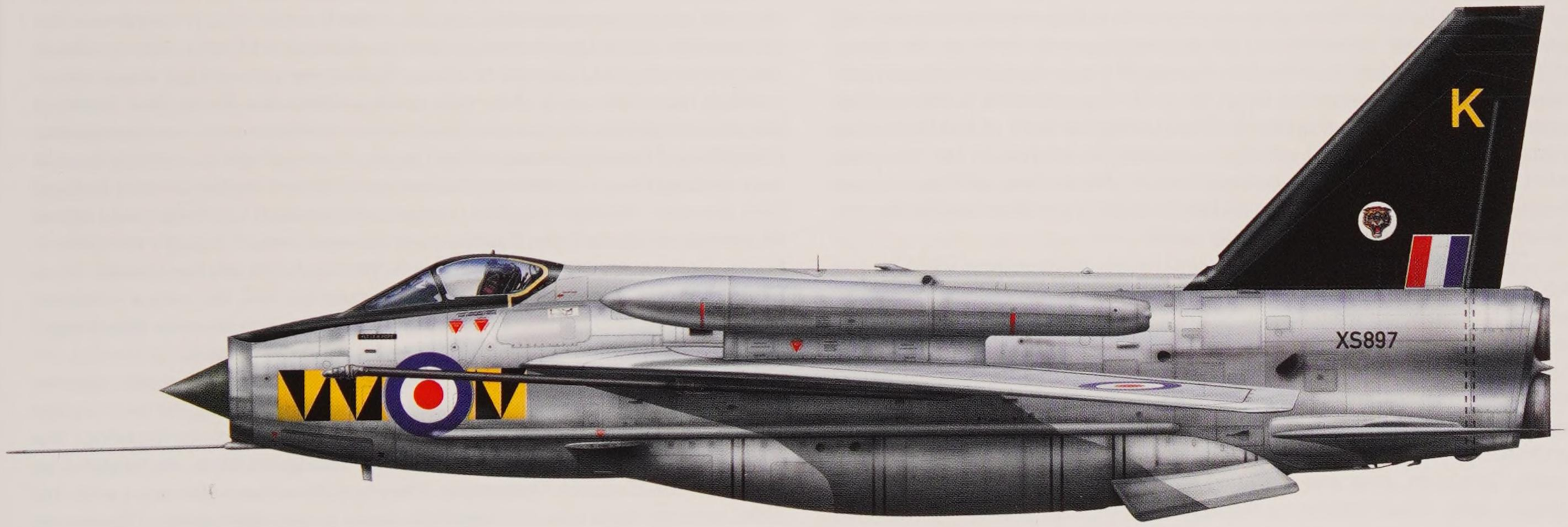
C/N 95079 ff R.P. Beamont 4.10.61. LCS 20.9.62. To 226 OCU (991) 6.63. Modification Centre Leconfield 19.7.63. 19 Sqn (T) 24.9.63. Damaged at Gutersloh and SOC 30.10.75 with 1634 hours. Allocated 8456M. Scrapped on site.

LIGHTNING F.2A, XN781, 19 Squadron 1968

C/N 95134 ff T.M.S. Ferguson 12.12.62. 19 Sqn (J) 15.3.63. To 33 MU Lyneham for storage 27.1.65. To Warton 13.9.66 for conversion to F.2A standard. To 19 Sqn (B) 26.2.68. SOC 1.4.77 and flown to Leuchars 5.4.77 on final flight with 2750 hours. Airfield decoy allocated 8538M. Dismantled and transported to Withington and subsequently scrapped 1990.

LIGHTNING F.1, XM146, 226 OCU 1963

C/N 95042 ff J.C. Hall 29.3.60. To 74 Sqn (coded L) 4.9.60. To Modification centre Leconfield 21.6.63. To 226 OCU (146) 30.7.63. To 111 Sqn (J) 13.7.64. To 33 MU Lyneham 1.1.65 for storage, last flight with 557 hours. Sold as scrap to B.A. Taylor, Bromwich, 11.66.



LIGHTNING F.6, XS897, 74 Squadron 1966

C/N 95243 ff R.P. Beamont 10.5.66. 74 Sqn (K) 21.12.66. To 56 sqn (S) 5.9.71. To 60 MU then Binbrook prior to ferry flight to Cyprus. To 56 Sqn 9.2.73, to Wattisham 30.1.75. Binbrook ASSF 17.7.76. To 11 Sqn (H later BE and BC) 23.9.77. To 5 Sqn (AC) 24.1.86. Final flight 14.12.87 with 3391.55 hours. Open storage 4.88. Sold to G. Beck, removed to Rossington 15.7.88. To Firbeck then Aeroventure, Doncaster 4.6.00.

LIGHTNING T.4, XM972, 226 OCU 1963

C/N 95072 ff D. de Villiers 29.4.61. To LCS (J) 2.7.62. To 19 Sqn 30.11.62. Modification centre Coltishall 7.1.63. To 226 OCU (972) 6.63. Rudder lost in flight 7.3.67, landed at Coltishall. To 60 MU 10.7.67. To 226 OCU (972) 15.2.68. Waddington for fire/rescue training 11.6.74 with 2012 hours. Destroyed 1981.

practice interceptions, or PIs as we knew them. These could vary from close control where the GCI – in our case Patrington – would tell the fighter what to do, and attempt to roll him out 2 miles behind the target, to PIs where we were just told the geographic position of the target and left to our own devices.

'The role of fighter and target was swapped between the two aircraft for each PI unless one of the Lightnings had an unserviceable radar. Our goal was the Dacre Trophy, and to win this we had to complete all the tasks that had been allocated to us by Fighter Command. The completion of the task was recorded in the form of statistics, and the squadron stats officer had a very important role in ensuring we ticked all the boxes each month. We were required to complete a specific number of subsonic PIs, supersonic PIs and high flying PIs, and also to carry out a number of ILS and GCA letdowns. Tanking and ECM were also part of the deal. I'm sure there were other things too, for instance, a flapless, feel-less single engine approach ticked many boxes!

'We were lucky on Five in that we had the first big ventral-tanked aircraft, and so we could complete all the supersonic work without too much difficulty. I recall when at Wattisham for one of the Queen's Birthday Flypast weeks acting as a supersonic target for a 111 Squadron Mk.3. GCI made a mistake with the set up and the Mk.3 had to recover short of fuel before the situation could be rectified whereas I was still fat for fuel. In fact one year after the Flypast on Saturday, during which the Mk.3s were calling minimum fuel just after the Palace, we completed the flypast, overflew Wattisham and returned to Binbrook just because we could!

'The first pair launched at 08:30 hr and the second at around 09:15 hr. The Mk.6 sorties were usually around an hour long and so the first pair recovered at 09:30. Often these would be turned round and re-launched at 09:45. They landed again at 10:45 hr for a normal turnround and re-launch at 11:30 hr. Usually the same pilots stayed with the aircraft and so by 12:30 hr they'd flown three sorties and were off to mess for lunch. The second and third waves carried on, also stopping for lunch. At around 14:00 hr the night shift arrived. They usually flew one sortie in the afternoon and maybe two at night. Of course, that was the ideal and not often achieved because the aircraft went unserviceable or the weather was bad. One thing that Five squadron pilots did get used to was diverting, as Binbrook was on top of the Lincolnshire Wolds, and bad weather was a frequent hazard.

'With luck a normal day consisted of getting up at 07:45 hr – I lived in the mess at the time – and flying four sorties. In those days the normal week was Monday to Friday so weekends were free unless we were on QRA. A word must be said about our engineers who worked tirelessly to meet this demanding programme. I believe that during 1967 and 1968 the hangar was working nearly 24 hours a day to support the flying task. This was great for us bachelors but not so great for the married men. We had an establishment of 12 F.Mk.6s and one T.Mk.5 and would usually start out with six to eight serviceable aircraft. This number reduced during the day but some were returned to flying duties after rectification. No.5 Squadron was fortunate in that in 1966 we had brand new interim F.Mk.6s and by 1967 we were returning these to BAe at Warton and collecting new F.Mk.6s. This helped us keep up the flying rate as we were always faced with some aircraft long-term sick with fuel leaks from the wing centre section.

'A day when the squadron was on QRA differed in that we were two aircraft down (in the Q shed on readiness) and two pilots down. The loss of pilots wasn't a great problem as the Q pilots could be used on the programme and be replaced on Q by two others who had already flown four sorties. This was meant to be the limit, although I twice flew six sorties in a day. So for the Squadron the training task continued. For the Q team of two pilots and four ground crew there was nothing to do but sit and wait. But first the aircraft had to be checked to make sure that they were serviceable, then "cocked" for scramble and all the communications checked for serviceability. We were usually scrambled for practice once a week if we hadn't had a live scramble so we had to be ready to fly. The situation of Binbrook in the south meant that we rarely saw the Russians. In fact, the closest I got was to be at "cockpit readiness" as a *Bear* was coming down the North Sea. Sadly, it turned back. So we sat around all day in our immersion suits and read books, played board games or watched TV. Usually, the highlight was eating and we were lucky to have a kitchen to prepare food. The alternative of food coming from the mess resulted in a cold unappetising meal. A scramble could either be unannounced or, if the Russians were being tracked through the Iceland Faroes Gap, we could be prepared for it. We would usually be brought from 5 min to 2 min, which involved hitting a scramble bell, donning a pressure jerkin, running through to the aircraft, hitting a switch to open the hangar doors on the way and climbing up the ladder into the cockpit.

'Meanwhile the ground crew would start the Houchin starter, get the electrics on line and climb up the ladder to help us strap in. As soon as the electrics were on line the MRG button was pressed in to bring the instruments on line. Once strapped in we would check in on telebrief to Patrington or Binbrook Operations. They would either hold us or give the order to scramble. From memory this would go something like: "Binbrook, scramble one Lightning." Binbrook Operations would come up on telebrief and nominate the mission number to be scrambled: 'Mission 12 heading zero nine zero, make flight level three six zero, call Patrington on Stud five. Scramble scramble scramble.'

'As soon as you'd noted and acknowledged the information the gang bar was checked up and engine number one was started. You watched the voltmeter which dropped as the engine fired and then recovered. As soon as the voltage recovered number two was started. That was accelerated to fast idle, the ac/dc warnings checked out and brakes released. The Houchin was

on a pull-off plug, as was the telebrief, and both disconnected as you taxied forward. The nose wheel was in a metal channel as there was only 6in clearance for each wing.

'As you came out of the shed you called ATC, who'd also been listening on telebrief, and they usually cleared you to take off immediately. Occasionally there was a landing aircraft to clear. This gave rise to the apocryphal story of one young pilot coming out of the Leuchars Q shed and selecting reheat. He then looked up and saw a Lightning plus brake `chute coming towards him and he uttered the immortal line: "You go left and I'll go right!"

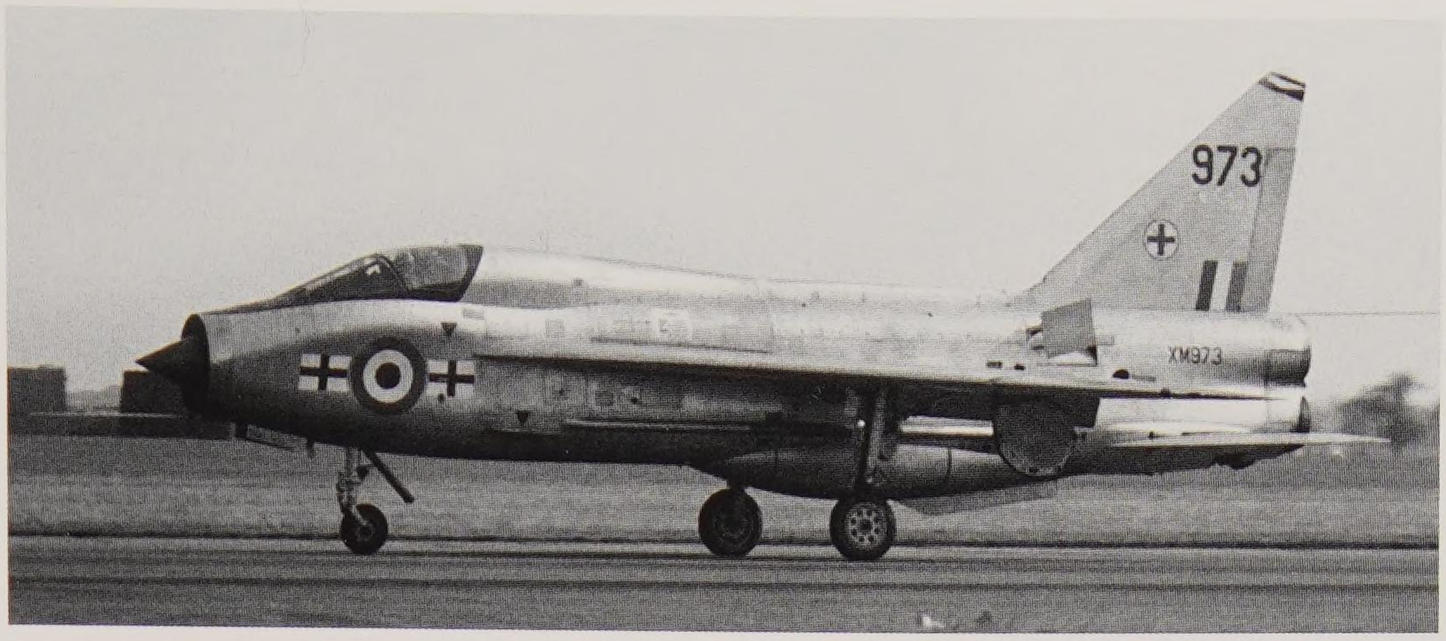
'A check would be made to ensure flaps were down and the standby generator was working. Main generator was selected, and the warning panels checked to make sure all lights were out. A quick closing of the canopy and a check of the `chute bolts to show it was locked and reheat was selected on both. The initial acceleration as reheat was selected was markedly reduced as the nozzles opened and the thrust reduced. This just gave you time to kick the aircraft straight on to the runway centreline before the reheat lit and you were off down the runway. In demonstrations with two of us already strapped in the cockpits, we could get the second aircraft's wheels in in under 1.5 min. Once airborne we would keep the burners in so as to get above the Blue Airway that went over Grimsby out into the North Sea. In those days it had a maximum altitude of 25,000 ft. We would then check in with the MRS at Patrington for instructions. These could be vectors to intercept a blip that needed identification or just to burn off and land as soon as possible. In other words, this was a practice to see if the system was still awake. Back at base, the squadron was very interested in the serviceability of the aircraft since if it was unserviceable another would be needed within the hour. Therefore, we had to check in with the aircraft's serviceability as soon as we could.

'Task complete we'd recover to Binbrook and back to the Q shed for a coffee. So went the 24 hours on Q. Weather played a big part. A lot of the squadron were inexperienced and only held white instrument ratings. This meant that we always needed to have a green rated pilot on standby in case the weather fell below white limits – about 400 ft cloud base. During the winter months this was a fairly frequent occurrence. If the weather got significantly worse we would then have to inform Patrington we might not be able to recover, and this would mean no practice scrambles. There was always a debate about whether to sleep fully clothed or to undress and be comfortable. There were champions of both courses of action and I don't believe that either materially affected our ability to meet our readiness states.

'Years after my time at Binbrook, my association with the Lightning resumed at Boscombe Down when I went through the Empire Test Pilots' School in 1982, and came back on the staff in 1985 after a tour at RAE Farnborough. The aim of the ETPS is to train pilots from around the world to be able to test all aspects of both military and civil aircraft. To this end the school has a variety of aircraft ranging from training types (in my time Jet Provosts but now Tucanos) to larger aircraft such as the BAC 111, and also includes representative front line fighters. A Lightning T.5 was on the strength of the school for most of the time I was associated with ETPS. I made the last flight on this aircraft on 13 August 1987 when I flew with Don Spiers, who was then Controller Aircraft at MOD PE.

'I believe there's team which has been trying to get the aircraft (XS422) in to the air again in the USA. In 1982 while I was on the course I managed just over 4 hr on the aircraft in a year. This illustrates the problem AAEE had in keeping the aircraft serviceable. In general the courses got little flying out of the Lightning. In late 1987 it was replaced by a Tornado F.2 and we had to promise not to fly too much fatigue off it as the Tornado OCU had used up most of the fatigue on the F.2s while they were operating them. Looking at my logbook, when I was on the staff in 1988 I'm not sure the Tornado provided much more flying than the Lightning.

'The Lightning was used to provide a glimpse of supersonic handling. However, its interesting points were not always picked up by the students. One that was frequently demonstrated was static instability in the transonic range. As speed increased between Mach 0.98 and Mach 1.02 there was a need to trim back, whereas conventionally static stability is shown by a need to trim forward as speed is increased. The Lightning got away with this because the trim change was very slow and easily controlled by the pilot. In fact, while I was on 5 Squadron I didn't notice this and I'm sure not many other pilots were aware of this trait either. The other areas the Lightning demonstrated were the reduction in roll rate when supersonic and the use of energy management to achieve best rates of climb.



XM973 was initially assigned to the AFDS at Coltishall prior to joining the OCU and eventual transfer to No.19 Squadron in Germany. (Photo: David Taylor)

'The small ventral-tanked Lightning was always tight on fuel and, as all our sorties used considerable reheat, the ETPS trips were always interesting. The usual profile was to take off and transit out towards Portland Bill or The Needles. We would be under radar control and the controller would point us in a safe direction to avoid us dropping a boom on land and allow us to accelerate. Depending on the task, we'd be between 10,000 ft and 40,000 ft. Most tests involved accelerating to Mach 1.3 and then carrying out some sort of manoeuvre. We used to demonstrate the roll rate at Mach 0.9 which was fairly sprightly, and then accelerate to Mach 1.3. There the student would find that the roll rate had become distinctly pedestrian due to the aft shift of the centre of pressure at supersonic speeds and reduction in aileron effectiveness.

'While all this was going on the tutor was watching the fuel like a hawk. The 250 lb in each flap was always constantly checked to make sure the flaps were feeding. This was done by pressing a button and watching the fuel gauges 'plus up.' As the tank fed the plus up figure reduced to zero. In most cases we used to glide back at Mach 0.88 with both engines at flight idle until we needed to increase the RM of number two in order to keep the AC electrics on line. They went off-line at around 60 per cent and at height idle, RPM was above this but reduced to be 23 per cent on the ground.

'While I was a student one of the exercises involved acceleration at various altitudes and then calculating the best climb schedule from 10,000 ft at Mach 0.9 to 40,000 ft at Mach 1.3. This sort of data would have been used by front line pilots to plan intercepts on fast, high-flying targets. The level accelerations were fun, but the real fun came in trying out your solution to achieve the best time to height. The solution wasn't a constant Mach climb, but involved one to the mid twenties and acceleration, by pushing over to zero g, to Mach 1.3 and continuing to 40,000 at 1.3. In 1982 the Lightning didn't stay serviceable long enough for us to try the climb. Therefore, when I returned to the staff I changed the test by giving the students the acceleration data and allowing them to calculate and fly the climbs. Quite a lot of fun was had by all and I believe that the students got more out of the test as they had to fly the profile very accurately to get good results.

'In the early days the Lightning pilots were known as 'the league of little men' as there were quite strict anthropometric limits on pilot size due to restrictions in the dimensions of the cockpit. We used to tell the students what the limits were and then check that they could fit okay. In 1986 the USAF student Mike Keane (who was later killed in an aircraft accident in the USA) was just on the limits with regard to thigh length and elected not to carry out all the exercises since he risked damaging his knees. However, such was the Lightning's charisma that he asked for one familiarisation trip. He launched with Ron Rhodes, our QFI. About 10 min later I was called to Ops as the Lightning had a gear problem.

'Any failure of the undercarriage to lock down on a Lightning meant ejection as a wheels-up or partial wheels-up landing was not permitted. They'd tried a couple of cycles but had had no joy. Ron was checking to see if there was anything else he could do before trying the emergency system. If this failed they would have to bang out. As they hadn't used too much fuel we had about 15 min to research the problem. I got hold of the drawings and put a call through to the OCU at Binbrook to see if there was anything Ron could do. The answer was no: there was only the one chance. I relayed this to Ron. Happily the gear came down and they got three greens and landed safely. Mike didn't fly the Lightning again!'

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XM970

XM970 pictured at Middleton St. George shortly after having become the first T.4 to be delivered to the RAF. After joining the LCS, the aircraft remained with the OCU until joining 19 Squadron in Germany during 1976. (Photo: Ken Goodwin collection)

T.M.4 XM987 spent her entire RAF flying career with the OCU before being relegated to crash and rescue training at Coningsby, complete with 'toned down' camouflage for duties as an airfield decoy. (Photo: Terry Senior)

Another photograph of XS422 (see page 63), a long-term resident of Boscombe Down, serving with the ETPS for many years. Despite this fact, the aircraft did not fly too often and (like many Lightnings) spent a considerable amount of time in the care of the base's engineers. In spite of this the aircraft was of course hugely popular with ETPS instructors and students, providing performance and handling that no other aircraft could offer. (Photo MoD PE)

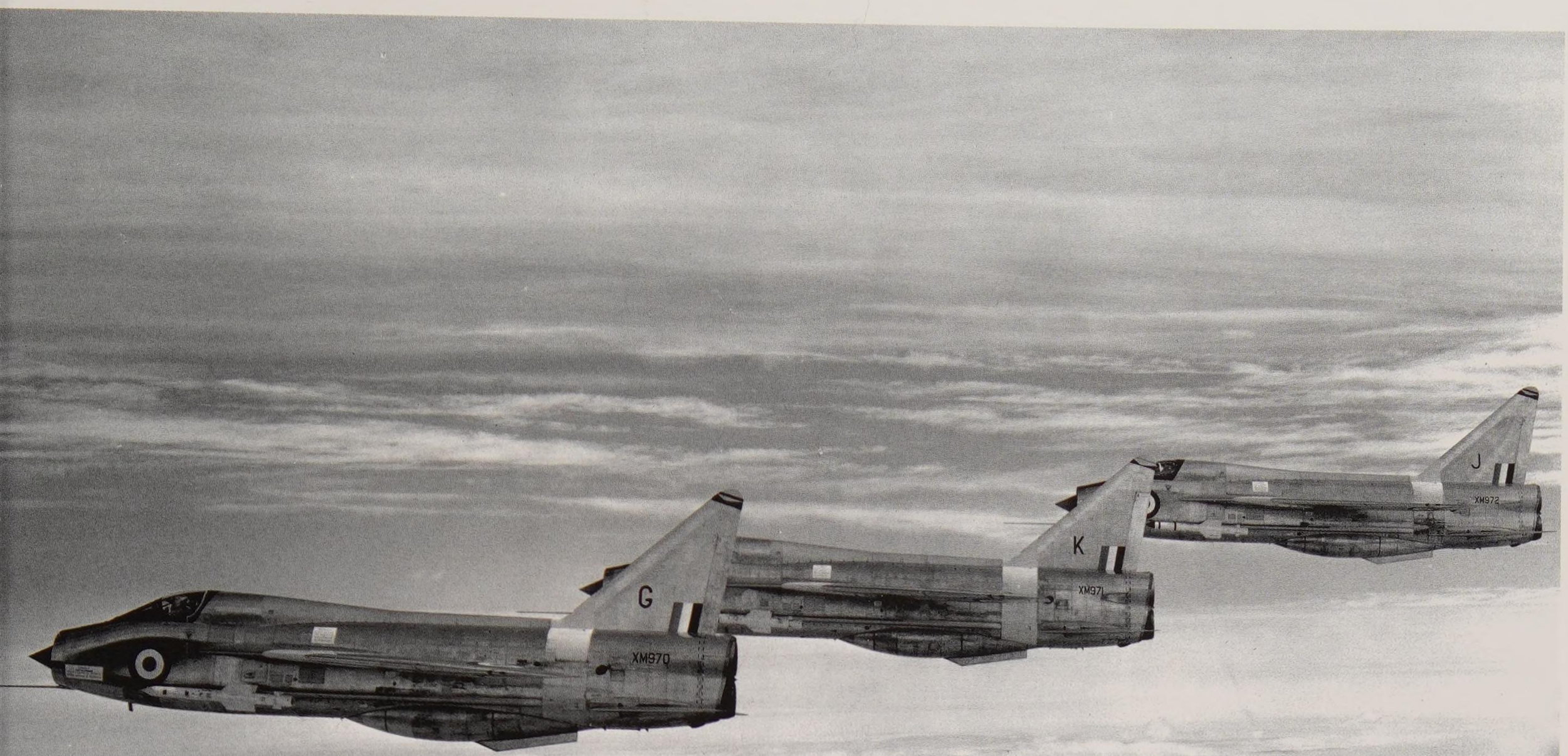
F.Mk.6 XS929 thundering back to Luqa's runway after completing a PI exercise over the Mediterranean. This particular aircraft still remains out in the Med, on permanent display at RAF Akrotiri. (Photo: Richard Caruana)

XR727/BH on final approach to Binbrook during January 1988. The aircraft was retired four months later and became an airfield decoy at Wildenrath. (Photo: Tim McLelland)

Although serving with No.11 Squadron at the time this photograph was taken (and with traces of 5 Squadron's markings visible on the tail fin), XR756 was painted-up in the markings of No.23 Squadron (a unit with which the aircraft had previously served) for the Lightning's 25th anniversary celebrations at Binbrook. (Photo: Terry Senior)

The precise reason for the dayglow orange markings applied to the fin, tailplane and wing tip leading edges of XS901 (and XR727/F) remain unclear. Some sources claim that the markings were intended to portray the two aircraft as 'bogeys' during an air show demonstration in 1978 although others believe that they were carried-over from an air defence exercise. The nose marking was applied during a visit made by Waffenschule 10. (Photo: Terry Senior)

A glimpse inside one of Binbrook's hangars showing a mix of Lightnings from the resident units together with P.1A WG760 which was stored at Binbrook after restoration, prior to joining the RAF Museum at Cosford. (Photo: Terry Senior)



A rare photograph of the first Lightning T.4s assigned to the LCS at Middleton St. George, airborne over the North Sea. The LCS aircraft received no unit markings other than a tail code but when the unit later became the OCU, the more familiar red and white markings of 145 Squadron were applied to the fleet. (Photo: Ken Goodwin collection)

Unusual photograph of XS456 on a typically wet and gloomy day at Binbrook, her ventral tank detached and mounted on a trolley. A member of the ground crew can be seen, about to attach a FOD guard to the intake. (Photo: Terry Senior)

A trio of Lightnings pose for the camera over Spurn Point, a familiar landmark for Lightning pilots. The three Binbrook units are represented in this photograph with a T.5 from the LTF leading the formation. (Photo: MoD)

Right: A pair of Lightning F.6s from No.111 Squadron getting airborne from Luqa en route to Akrotiri, with a visiting Britannia and a resident Canberra in the background. This picture illustrates how the nose gear retraction sequence always lagged behind the main undercarriage and had to be quickly completed before the retraction limiting speed was reached. (Photo: Richard Caruana)

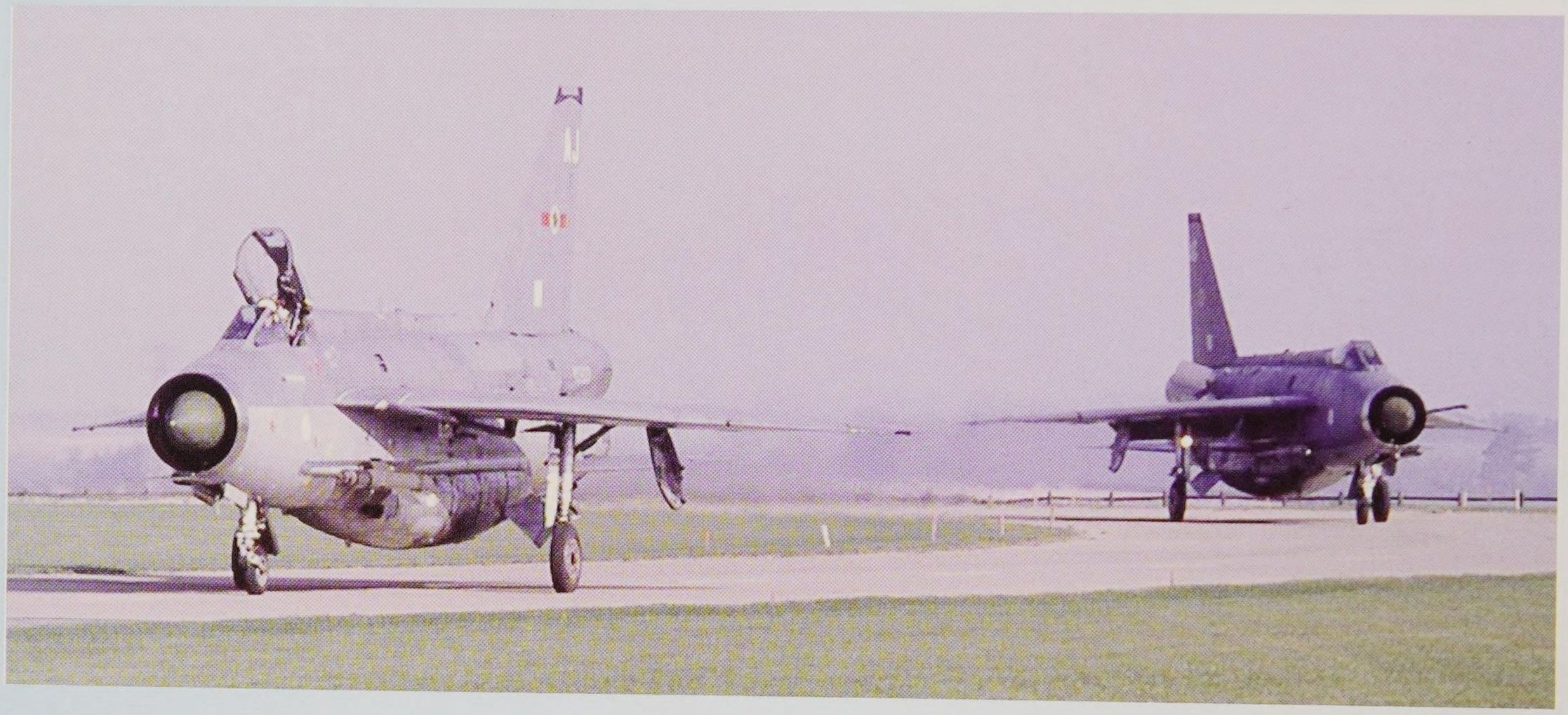
A trio of No.5 Squadron's Lightning F.6s, enjoying some post-shower sunshine at Binbrook. As can be seen, the Lightning fleet had their own purpose-designed access ladders which clipped into recesses on the aircraft's fuselage, and were designed to cater for the presence of Firestreak or Red Top missiles when carried. When the aircraft succumbed to camouflage in the mid-70s, even the access ladders and all other ground equipment suffered the same fate. (Photo: Paul Tomlin)

Ground crews often commented that if a Lightning wasn't leaking, it was probably empty. XS898 is visibly venting fuel whilst taxying to Binbrook's runway for take-off. (Photo: Terry Senior)

T.Mk.5 XS419 captured in crisp winter sunlight at Binbrook shortly before withdrawal in February 1987. Sadly, the aircraft was removed and cut-up as scrap just over a year later. (Photo: Terry Senior)

F.Mk.6 XS922 enjoyed a relatively uneventful service career but was victim to continual fuel leak problems which culminated in an engine fire prior to take off during August 1970, and is pictured back at Binbrook following repairs at 60 MU Leconfield. (Photo: Terry Senior)

A pair of 5 Squadron F.6s returning to Binbrook after completing a sortie over the North Sea. Both aircraft are carrying Aden guns and whilst the lead aircraft is fitted with a pair of Firestreaks, the second aircraft carries a pair of Red Tops. The line of sticks positioned beside the taxiway was necessary to mark the edges of the concrete on the many occasions when the airfield was covered with snow. (Photo: Terry Senior)



XR773 was resprayed at Binbrook but emerged to resume flying duties after having had only a coat of yellow primer applied, subsequently returning to the hangar for completion. It was (albeit briefly) the only yellow Lightning ever to have taken to the air!
(Photo: Terry Senior)

Chapter Five

LIGHTNING LIFE

JOHN CARTER was another RAF pilot who joined the Lightning force later in the aircraft's service career. Not only did he fly the Lightning but he also had the opportunity to fly other contemporary fighters in the United States. He says: 'I often read through car reviews and see the fairly frequent use of phrases like 'feel' or "connection" or "poise." Aeroplanes have some very similar attributes but the romantic notions sometimes associated with them occasionally lead to even more esoteric descriptions. There's an old adage that an aircraft which looks good will fly well and this can certainly be borne out by the Spitfire, Hunter and F-16. Their design implies poise and balance and, having flown the latter two, I can readily attest to the fact that the theory is valid.

'I'll make comparisons later but first let's consider the impression the Lightning makes while sitting idly on the ground. As often described, the aircraft is large and in some respects strangely out of proportion. The cockpit is low slung and from the outside only the pilot's head is normally visible. The appearance is that of someone buried in the nose of a rocket. The fuselage is unusual in configuration due to the engines sitting one on top of the other. Fuel is housed in the wings and ventral (belly) tank which is very common in aircraft design but, given that both parts were changed and enlarged as the poor range became apparent, neither looks exactly organic. The jet sits tall and yet it squats. The impression is one of power, certainly not of poise.

'I think a clean F-4 Phantom has better lines, yet from what I've gathered it isn't half the pilot's aircraft the Lightning was. It may be a cliché but a person's first operational jet after flying training at the Tactical Weapons Unit seems a massive step up. This is despite the Hawk's admirable performance and genuine fast jet usability and is usually the case because of the additional systems and complexity associated with an aircraft doing a "real job." Navigation, weapons and associated aiming systems, radar, defensive aids, often another crew member, all added up to increased workload, more weight and what definitely felt like more substance and more intimidation.

'From a systems perspective this didn't really apply to the Lightning. The rudimentary nature of the radar and its ability to use up aviation fuel at an astonishing rate represented an airmanship test like none I'd experienced before. No, the Lightning was a step up because it had an aura. I guess the same could be said of the F-4. Somehow the Lightning, tucked away in a corner of Lincolnshire and apparently on the brink of retirement, was an aircraft of legend: rotation take-offs, phenomenal climb rates, Mach 2.0 speed. In addition, the pilots were a definitive breed. The "last of the few," they were viewed with respect by the fast jet community but were somehow representative of the distant past.

'I was posted to the Lightning with no idea what I was about to face. I certainly felt that my training hadn't prepared me for what was to come. The aircraft itself is surprisingly big or perhaps better described as tall compared

T.Mk.5 XS417 was the first production Lightning T.5 to fly. Pictured wearing the markings of No.56 Squadron, the aircraft was subsequently operated by all three Binbrook units before being retired to the Newark Air Museum where the aircraft is currently on display. (Photo: Dick Lohuis collection)

A former 'Firebirds' aircraft, XM172 left 56 Squadron to join the OCU at Coltishall, eventually adopting the markings of No.65 Squadron as pictured during a visit to Binbrook. (Photo: Terry Senior)

to the Hawk. While on a 'holding' tour of six months between RAF Valley (AFTS) and RAF Chivenor (TWU), I'd been fortunate to fly both the Hunter and the Jaguar and neither appeared particularly intimidating. The Lightning was a different story. In the very early days of the Lightning Training Flight my three fellow students and I were shown around a T5 "tub" out on the flight line. The aircraft seemed enormous with its distorted nose section accommodating side-by-side seating. The wings, however, were slender and the undercarriage legs spindly with what seemed, even as a novice, ridiculously narrow tyres.

'The pitot tube extending from the bottom of the intake was extravagant and caught out many of the unwary. It was also a prominent feature in any gun camera film as the camera was also sited in the intake. I noticed another idiosyncrasy from the past out on the flight line where the operational squadron's aircraft were parked in rows. They were surrounded by their associated paraphernalia of fire extinguishers, Houchin generators, brake parachute containers. Almost all had drip trays underneath to catch leaking contaminants: fuel, oil, hydraulic fluid. It was said that if a Lightning wasn't leaking then it was empty. I experienced the wrath of many an OC engineering wing on other stations when I parked my leaky jet on his shiny new tarmac. The other striking thing when looking at a row of 25 Lightnings was that they all seemed to have a different colour scheme: various shades of air defence grey and camouflage harking back to RAF Germany days. As the squadrons approached disbandment special liveries were also adopted, usually for the boss's jet: red and black tails, sharks' teeth and the like.

Pictured at Binbrook following servicing, F.6 XS936 is positioned for an engine run with 'everything open'. (Photo: Terry Senior)

'It's a long way up the ladder when you first get into a Lightning. The cockpit is snug and much narrower even than a Hawk, an aircraft of half the size. The cockpit was also like nothing I'd ever seen although perhaps the Jet Provost came closest in terms of vintage, look and feel. A strip air speed indicator reminiscent of an Austin-Morris car, an attitude indicator that was wholly two dimensional and a TACAN/navigational display that "chattered" when different modes were selected like the machine that used to print the football results. That's the best description I can give. Any upgrades like radar altimeter were very much bolted on in as convenient a place as possible although usually appeared incongruous. Then there was the radar B-scope display shrouded by a rubber 'boot' not unlike a Wellington boot. It folded in two when stowed. This was necessary because the display was raw and subject to reflections. In fact the cockpit switches were placed logically and very much had the classic left-to-right layout.

'To assist fast start capability it had a gang bar that switched on some essential items like batteries, generators and pumps and the instruments could be brought on line in only 2 or 3 min. Quick Reaction Alert (QRA) demanded a launch from 10 min of an alarm. It wasn't uncommon to make it in eight from fast asleep – not in immersion suit but in bed – in the small hours.

'The Avpin starter kicked the motors into life dramatically and the whole jet reverberated with noise and vibration. The cockpit wasn't particularly well insulated from the rest of the jet, nor did it have sophisticated air conditioning like, say, a Tornado whose cockpit environment is like sitting quietly in your living room. You could sense and smell everything that was going on and feel the latent power. Releasing the handbrake, the jet moved forward briskly due to the idle and fast idle throttle settings. Fast idle on one of the engines kept the generator on line. A quick squeeze of the handbrake, a surreal contraption after flying training in the modern Hawk, and the nose dipped almost violently. This happened frequently taxying out as the idle power setting was very high and you had to dab the brakes continuously to keep the speed under control. It was said that a Lightning at idle thrust has more power than a Jet Provost Mk.3. In the T.5 or F.3 we conducted dry power take-offs unless we were going to do a "rote" – a rotation take-off. As such, the experience wasn't all that impressive, comparable to something like a Jaguar in reheat.

'A burner take-off was altogether different. There was a firm kick in the back as the burners lit. Acceleration was extremely impressive and after the Hawk it was all you could do to keep up with events. Gear and flap retraction needed to happen by 200 knots and that speed arrived almost straight after lift-off. The F.6 flew off the ground smoothly with its bigger and better wing but the T.5 needed a positive rearward stick input and felt like it needed dragging airborne – unless it was in afterburner – in an uncomfortable nose-high, tail-low attitude.

'The aircraft accelerated purposefully and soon took on the flying characteristics that identified it as a thoroughbred. Here's where it became the Jaguar – E-Type, that is, of the skies: brutally fast, yet always feeling connected, under control, providing continuous feedback. With some aircraft you can close your eyes and roll to a certain bank angle by feel. Yet if you tried that with others you wouldn't even be close because fly-by-wire, control harmonisation or the sheer agricultural nature of the jet tended to dull the feedback. The Lightning was beautifully poised and gave constant feedback. Later, when I became more experienced and proficient at combat, I could sense any diversion from controlled flight, usually manifested as a yawing slice of the nose, even when I was looking out the side of the cockpit or over my shoulder at an opponent on the other side of the 'circle.'

'Any diversion from controlled flight was quickly dealt with by a neutral forward press on the stick. Then you could quickly get back to the business of pushing the jet hard knowing you were near the limit. All this happened in a matter of moments. The Tornado was much more antiseptic and, probably due to the spin prevention and incidence limiting system [SPILS], it had an area of flight where it just felt 'disconnected' when pushed to the limit. You just felt it wouldn't do what you wanted any more and would just stop

F.Mk.3 XP694 from No.56 Squadron pictured at Binbrook, about to head home to Wattisham during 1975. After a long service life the aircraft was dismantled and transported to Otterburn where it was gradually destroyed on the ranges. (Photo: Terry Senior)

performing until you radically changed the dynamic. Interestingly, the F-14 achieved what the Tornado didn't. It provided the same feedback as the Lightning but introduced the complexities of asymmetric thrust, which precipitated most of the spins that led to abandonment. There was also massive nose authority due to the size of the horizontal tailplane. This allowed you to build angle of attack incredibly quickly and at much higher speeds. In the Tomcat we also used yaw as a tool in combat while instructing in the US Navy Reserve Air Group so we definitely pushed the boundaries more than we did on the Tornado. Yaw wasn't a recommended region of flight to be exploited in the Lightning, probably because the rudder just didn't have the authority of the Tomcat's.

'Thrust (or sometimes the comparative lack of it) was a factor in all these aircraft because it was one way to get you out of trouble in the Lightning and F-14. The lack of it got you into trouble more quickly in the Tornado. The Lightning had seemingly limitless power compared to anything I'd flown and that includes the likes of fully loaded F-18, F-16 and F-14. The F-14B was an altogether different animal with its two GE110 engines because that was definitely an aircraft with a lot of power. In the F-14B, burner take-offs couldn't be performed because if you lost an engine you had insufficient rudder authority to cope with the thrust asymmetry. If you were in reheat when an engine failed the other automatically trimmed back. The F-14B took off in dry power from the ship even when loaded with AIM-7s, AIM-9s, a complement of Phoenix missiles, fuel tanks and even a bomb load.

'The Lightning's excess of power was immediately apparent on take-off. The Harrier leapt forward on brakes-off, the Jaguar ambled down the runway. The Lightning's power was still apparent while accelerating to climb speed. In the Lightning that was 450 knots, converting to Mach 0.9. These were outrageous numbers when you'd experienced the Hawk, Hunter and Jaguar as I had. Not only that but it was extremely easy to exceed the speed of sound if you didn't maintain the appropriate nose-high attitude. The time taken to get to altitude also exemplified the fact that this jet had a lot of power.

'I recall operating north-east of Grimsby doing practice intercepts; we had to cross an airway that was called Blue 1 in those days. To expedite our passage to our operating area, a 'fighter gap' was created in the civilian airway through which we could pass while not under radar control. We therefore didn't have to talk to the civilian controllers. This was at a layer of some 24,000 ft one way and two 2,000 ft higher or lower coming back. It was a corridor very close to Binbrook. Not many aircraft could have reached the specified altitude in time to take advantage of the corridor but the Lightning did it comfortably. Another area where excess power came into play was in the airfield circuit. We flew very tight circuits for a particular reason. When I first joined the squadron there was a policy of fatigue preservation for armament practice camps because firing the gun over in Cyprus used up a lot of airframe life. Quite simply, nobody knew when the Lightning would be retired. Introduction of the Tornado F.3 with its infamous Blue Circle radar wasn't going well and the Lightnings were very old airframes. We were therefore forced to limit the amount of g we pulled and that led to an altogether dull period of flying for my first 12-14 months.

'When you were in the airfield circuit you didn't retract the gear and when it was down, the fatigue meter was isolated. A certain amount of frustration at the fatigue policy was vented and an aggressive, tight circuit was often flown with a deal of hard pulling round the corner upwind and on finals. In any other aeroplane this might have been risky in gear-down configuration, particularly when turning on finals, as the aircraft buffeted when flown on the correct path. If you flew the recommended pattern the throttles were set at a mere 80 per cent or so. If you wanted to be more aggressive you pulled harder, got more buffet but there was a vast handful of throttle available. You just balanced the two, thrust and drag. In effect, the aircraft was being held-off from a departure by the application of power and this appeared to be limitless. There's much more to dragging heavy aircraft around the sky while they seemingly want to fall out of it. No doubt a PPL in a Cessna would be appalled at the level of aggressive handling, but when you conducted "rotation" take-offs, effectively snatching an aeroplane through its stall and letting Newton's laws take over, or when you flew slow speed scissors manoeuvres in combat only a few hundred feet apart at the very edge of the flight envelope, it was always about finding out what you could get from the jet at its very limits.

'This brings to mind an occasion when I flew with a colleague some time after our early days of flying training. He'd gone on to fly the Hercules and then become a Jet Provost-qualified flying instructor. Every year on the Lightning we had to undertake spin familiarisation in a Jet Provost because it was forbidden to intentionally spin our aircraft. The spin recovery technique was the same for both. I arranged to have my old mate come over to do my spin "famil" and in return I later took him for a trip in the squadron's Lightning T-bird. After completing the requisite spins in the JP he asked me if I wanted to do some aerobatics "like the old days", loops and stall turns and the like. To cut a long story short, he became alarmed at how I was prepared to aggressively manoeuvre the JP at virtually zero knots and kept saying: "recover, recover." He was clearly alarmed at how near the edge of the envelope we were. I was merely exploring the aircraft's capabilities because that was now my instinct. In combat the pilot who won would be the one who'd get more from the jet without actually losing control. He was equally shocked by the violence of the subsequent rotation take-off in the "tub" and stunned that you could manoeuvre the Lightning at crazily low speeds because power was one way to hold off departure from controlled flight... something obviously not applicable in a JP!

'After my time at Binbrook I was posted to RAF Brawdy as a qualified weapons instructor. Early in my re-familiarisation with the Hawk, I flew with a QFI and he said: "Let's do some aerobatics." I didn't have a sequence or anything worked out but immediately pulled up into a loop... upon which he called for control and stopped the proceedings. He said to me, rather perturbed, that we hadn't done any pre-aerobatic checks, known as "Hasells." This was an acronym standing for height, airframe (are we configured properly?), security (strapped in, no loose articles), engine, location and lookout. He asked if we did them on the Lightning before combat. Equally incredulously, I said that we didn't do such checks as, strangely enough, we were fully aware of the status of the aircraft, its position too, and always kept a look-out. Plus, who exactly were we supposed to be talking to about these "checks?" I hasten to add that I was never a fan of the QFI school of thought which was very much at odds with the fighter pilot mentality. That effectively dictated that if you didn't know what was going on and weren't alert then you shouldn't have been there. Of course, QFIs are there to teach people, so all the checks are an absolute necessity. This is one reason why I didn't become an airline pilot after leaving the RAF as I was very clearly the "wrong stuff" and would have hated discussing everything that was happening on the flight deck.

Pictured shortly after returning from a sortie over the North Sea, F.6 XR769 taxies back to 11 Squadron's flight line. Just visible is the port Aden cannon port housed in the ventral fuel tank, prior to being modified with muzzle deflector rings which became standard in later years. XR769 had previously served with No.74 Squadron in Singapore. (Photo: Terry Senior)

Shortly before retirement XS897 was the subject of a celebratory repaint, receiving old-style high-visibility national insignia which contrasted starkly with the rather more recent grey/green camouflage which was applied in July 1977 (after which the aircraft mistakenly appeared as XS987). Although initially sold as scrap, the aircraft was rescued and is now on display at the Aeroventure Museum in Doncaster (under restoration). (Photo: Terry Senior)

F.3 XR749 taxies out to begin a practice intercept sortie during 1974. A former 56 Squadron aircraft, XR749 was later repainted in 56 Squadron markings during 1986 to mark the unit's anniversary, having previously sported an eye- catching blue-trimmed paint scheme as part of the LTF's celebrations. More recently, the aircraft has been placed on display in Peterhead, repainted in the LTF anniversary paint scheme. (Photo: Terry Senior)

'So despite having two missiles, which were particularly useless, bugger-all fuel and a radar that was rudimentary, the Lightning deserved its reputation as a pilot's aircraft. It gave superb feedback, had startling reserves of power, turned as well as anything out there, except the new generation of "unstable" fly-by-wire fighters, and was a package that meant that you had to be thinking every second you were in the aircraft. A case in point is the fuel load and associated range – or lack of it. Another old wives' tale often told was that if you took off in reheat and commenced a 60-degree turn you wouldn't make it back to the airfield before you ran out of fuel. Actually, this is technically true of most modern jets. You'd be accelerating and the turn could only be maintained by virtue of more bank and g. I knew what the tale meant: the jet drank fuel like nothing I'd ever experienced, particularly at low level. Ever since I became a reasonably adept pilot in the Lightning, I was someone who couldn't possibly run out of fuel. I was aghast at people's unsophisticated management of an aircraft's fuel and what it might enable you to do. As an example, when we undertook practice intercepts over the North Sea we'd continue an intercept to the point (dictated by fuel load) we'd calculated that we could terminate the exercise. Then at once we'd turn and climb towards Binbrook at dry power to an optimal height – the high 20s or 30s, depending on range from base.

'On level-off, we'd select an efficient minimal power setting and calculate a rate of descent and ground speed that would effectively mean we could glide to finals at Binbrook at virtually idle power. We could break overhead the airfield to finals, making one last power selection to arrive on speed at the threshold, landing with the absolute minimum. This was usually 1,600 lbs for a visual crash diversion to Waddington or Coningsby. It isn't that this was clever as such but, remarkably, we achieved it almost every single time. The fly in the ointment was that usually everyone was returning "on fumes." You really didn't need a queue when you arrived. Sometimes the weather wasn't as published, which led to many variations on what otherwise was some pretty adept airmanship. I hasten to add that you can of course run out of fuel or recover on minimum reserves with any aircraft. But my experience of other aircraft was that you could usually undertake a representative mission with the fuel on board and have an element of reserve. With the Lightning it was always about getting a quart from a pint pot. It was designed to take off and intercept a Russian bomber at high level where its fuel load could be exploited in its optimum environment. It wasn't designed to rush around Yorkshire chasing Harriers or Tornados at low level, or indeed undertake escort missions, AWACS protection or any of the other modern requirements.

'To their great credit Binbrook ATC played their part in recovering aircraft that were somewhat inflexible in their approach paths. To assist matters a "code" was developed along the lines of "requesting a straight in approach," or, if on a GCA approach, "request a tight feed in." This implied that you really did have bugger-all fuel and wished to be treated appropriately by ATC. The same applied to air-to-air tanker joins. More of that later. On more than one occasion chaos ensued. Only through luck, and not a little talent on the ground and in the air, was disaster averted. This happened most commonly when we had foreign visitors flying with us, and particularly when the weather was "iffy." It must be borne in mind that if you applied normal fuel reserve criteria, most of the time in bad weather we simply wouldn't have got airborne. Therefore, we pushed the limits beyond which I'd seen before or since. One particular time a detachment of French Mirages was at Binbrook flying dissimilar air combat (DACT) and other exotic sorties against us and other local squadrons. The weather was poor, both at Binbrook and at the local diversions, and everyone ran short of gas.

'Priority was given to the French, who obviously didn't know our code. There was every man and his dog scattered to the winds, IFR and very short of fuel. One feature of the ensuing debacle was the obviously anxious tones of the Lightning pilots. They knew they'd get the best service from home base but were facing diversions to places like Waddington and Coningsby which had their own problems. In the end nobody crashed and the escapade was consigned to the annals of "I learned about flying from that." But it was very close to going horribly wrong. In among similar occasions a very experienced pilot landed at Swinderby – when it was closed! Essentially, he got to the stage of banging out or dumping the jet on any piece of concrete that appeared in a gap in the clouds. This all points to an irrefutable fact: the Lightning was operated at its practical limits and too much of the time beyond them. On one level it bred pilots who pushed the limits as a matter of course but were confident of their capabilities and set new boundaries. But in reality the jet really didn't belong to the age in which I flew.

'Lightning pilots were particularly good at air-to-air tanker joins because our bread and butter intercept was a stern conversion which could be tightened as a function of geometry rather than using power and fuel. Usually you could roll out literally 100 yrd behind the tanker with a steady 30 or so knots of smooth overtake. Later, when I was a flight commander on 5 Squadron flying Tornado F.3s, I was exasperated by the appalling tanker joins that most of the crews led me on, with roll-outs of 3 miles-plus and a 2 to 3 min catch-up to the tanker, which in itself was wasting ridiculous amounts of fuel. Of course, no one cared – they all had lots in reserve. I just felt it was bad airmanship and poor radar and flying skills.

'On one particular join on a VC10 while on detachment in the `States, I was number four of a flight of four and the leader set up the most atrocious head-on geometry to join the tanker which was doomed to fail. I had the other flight commander in the back seat. He was a mate who'd grown accustomed to my idiosyncrasies and strange ways and he couldn't believe what the leader was doing. Instead of following him as I should have done, I turned early and rolled out just behind the tanker. The rest of the flight screwed up the join and rolled out 11 miles behind, completely confused as to why a Tornado was plugged-in on the right hose. It was a "silent" join and tanking could be undertaken using lights as signals. Now, let's get this straight: my behaviour was indefensible and as a flight commander I was setting an appalling example. But I'd simply got fed-up with being led around badly. Of course, the other flight commander in my "boot" was laughing his socks off!

'Not only could we Lightning pilots join efficiently but it was considered very bad form to miss when trying to plug in. The jet tanked easily because of the excess power and I used a technique of just tickling the left throttle only to move forwards or backwards. The fact that you couldn't see the end of your refuelling probe meant that a good line-up and smooth flight path almost guaranteed a plug first time. It was very different in a heavy Tornado which couldn't tank very high, 26,000 ft or so maybe max. By comparison, I once tanked in a Lightning over France on the way to Cyprus at 40,000 ft or so and this was still not a problem. In the Tornado big handfuls of power were required with a lag in any motion.

'I also saw too many pilots "chasing" the basket in the Tornado. They could see the probe and basket in their peripheral vision and this inevitably led to a miss or worse still a "spokes." In the Lightning there were other "codes" associated with tanker joins. A particular request was for a "stern join" whereby you didn't come up on the wing of the tanker as per the SOP, but positioned on your join straight to the holding position behind the basket, probably not even pausing before you plugged. This request was made because you were particularly short of gas. If there were Lightnings plugged in when the join request was made, one or both would quietly unplug and move back to the echelon position. There they could wait for their colleague – who clearly needed fuel ASAP – to finish. When he departed it was usually with a humble "thanks" and you simply moved back to the basket and resumed.

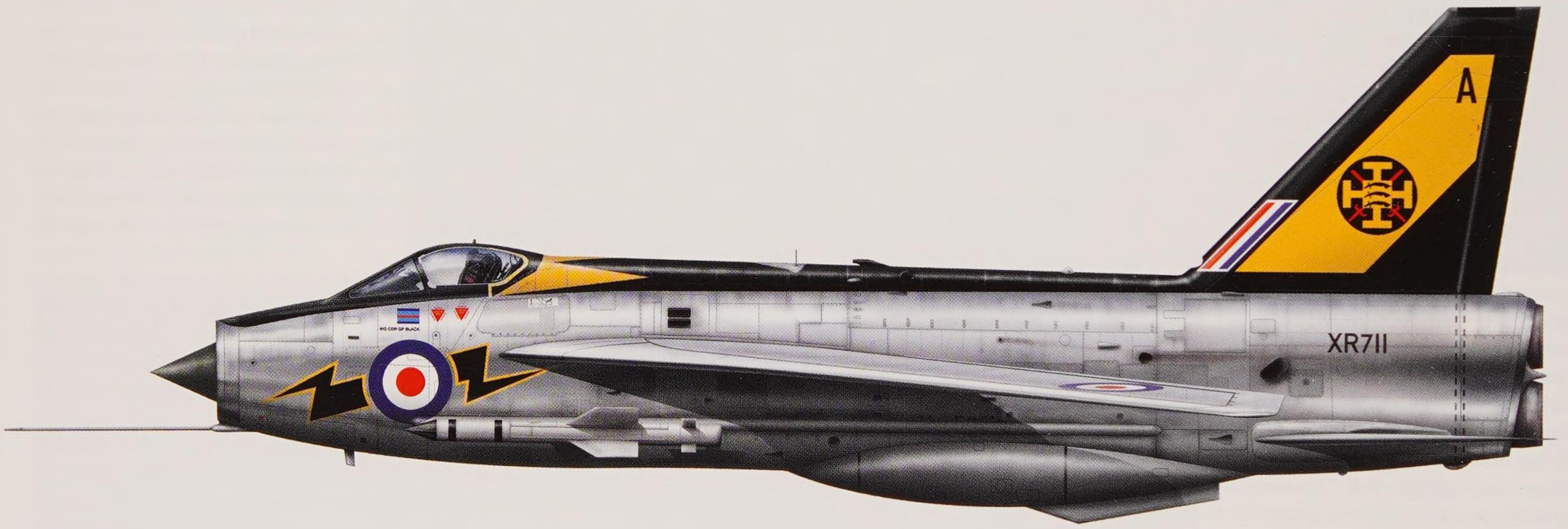
One example of this was when a pilot, who shall remain nameless, joined and uplifted 10,800 lbs of fuel, the total capacity of an F.6 being 10,600 lbs. Now, the reason he could take on more than the jet's capacity was because he would have been using a bit of fuel while filling up but he could have been on fumes when he arrived at the tanker. We were 80 miles from the nearest airfield: there was a pilot who pushed his limits!

'A fast jet is deployed in accordance with the capabilities of its weapons system. That's its *raison d'etre*. We had two 30-degree stern aspect, one mile-range missiles, plus or minus. And yes, you could fire a Red Top head-on at a 1.5 Mach target, although having witnessed them spiralling into the sea when firing them at Aberporth Range I have my doubts. Therefore, the bedrock of the Lightning pilot's training was utilising the radar to position for a stern intercept, rolling out at approximately a mile to a mile and a half. This became my life and while challenging, it wasn't the most exciting flying I'd experienced. It was a case of understanding geometry, having the dexterity to manipulate a series of switches and the radar's functionality and being adept at flying accurately. Oh yes, and knowing exactly where you were and how much gas it took to get home – precisely how much. One beauty of the art of PIs was that it used hardly any fatigue and that became my flying experience on my first fighter squadron. Frankly I hated it.

'My friends were flying Buccaneers and Tornado GR1s at low level, turning and burning with my other mates in their F-4s chasing them and I was droning about the North Sea doing endless PIs and running and breaking over the airfield at 2g. In short, I'd have swapped places with any of my classmates despite being allocated what was the only available single

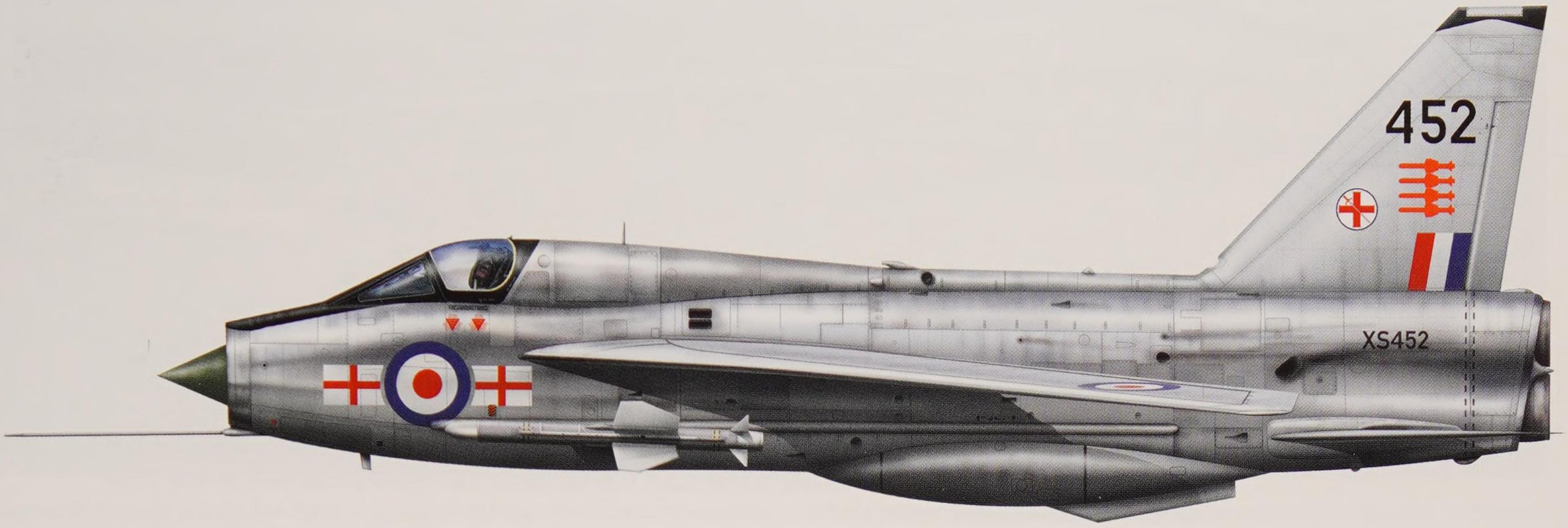
LIGHTNING F.6, XS935, 23 Squadron 1968

C/N 95268 ff R.P. Beamont 29.5.67. To 60 MU 18.7.67, storage and continuation training. To 23 Sqn (J) 3.1.68. To 5 Sqn (B) 30.1.76. To ASF then 5 Sqn (J later AB and AK) 11.7.80. Final flight 8.9.87 with 3602.30 hours. Spares recovered then placed in open storage 29.4.88. Sold to G.Beck and removed to Rossington 15.7.88. Scrapped 4.12.92.



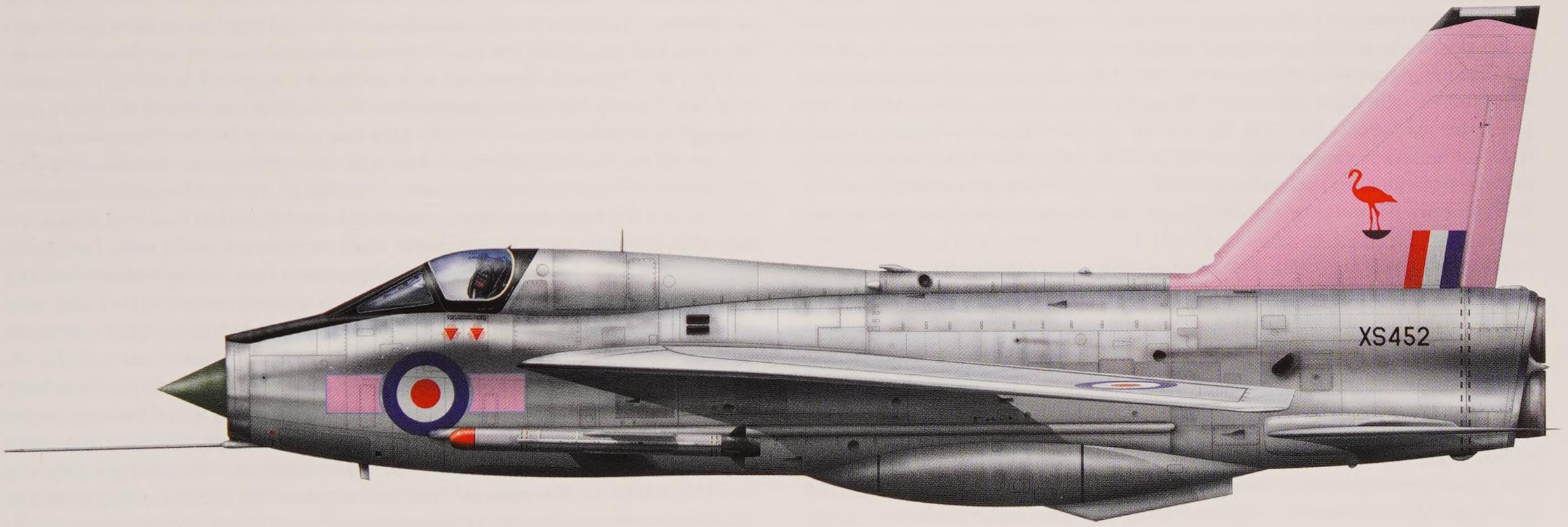
LIGHTNING F.3, XR711, 111 Squadron 1964

C/N 95194 ff D. de Villiers 6.10.64. 111 Sqn (A) 2.12.64. To 60 MU 24.8.67 then returned to 111 Sqn. SOC 3.11.74, aircraft sank onto runway during take-off. Pilot Eric Steenson uninjured. 1667.25 hours. To Wattisham dump, scrapped 10.75.



LIGHTNING T.5, XS452, 226 OCU 1965 and Akrotiri Station Flight 1975

(see below)



LIGHTNING T.5, XS452, 111 Squadron 1974

C/N B1/ 95012 ff D. de Villiers 30.6.65. 226 OCU (452) 20.9.65. To 60 MU then 111 Sqn (T) 11.11.71. To 29 Sqn (X) 12.10.72. To Akrotiri 14.1.74 with 111 Sqn, assigned to 56 Sqn (X) 18.1.74. To Akrotiri Station Flight. To Binbrook 21.5.75. To 11 Sqn (Y) 7.75. Loan to 5 Sqn and LTF. To 11 Sqn (T) 10.5.77. To LTF (Z later DZ) 30.6.80. To 11 Sqn (later BT) 18.3.85. Sold to Arnold Glass, flown to Cranfield 29.6.88 with 3011 hours. Sold to Tony Hulls Consortium 27.11.93. Sold to Mike Beachyhead, shipped to South Africa 9.98. Registered ZU-BBD. Maintained in airworthy condition.

LIGHTNING F.6, XR773, 56 Squadron 1974

C/N 95238 ff R.P. Beamont 28.2.66. 74 Sqn (F) 7.11.66. To 56 Sqn (N) 5.9.71. To 60 MU via Luqa 17.8.73. Binbrook 18.1.74 for preparations prior to ferry flight to Cyprus. 56 Sqn (N) 12.2.74. To Wattisham 21.1.75. To 5 Sqn (B later A) 3.3.75. To 11 Sqn (D) 27.7.76. To 5 Sqn (AH) 8.6.81. To LTF on load (F) 24.9.82. To 5 and 11 Sqns various periods on loan. To 5 Sqn (AF) 23.2.83. To 11 Sqn (BD) 5.11.84. To LTF (DF) 24.4.85. To 5 Sqn (AB) 21.1.86. To 11 Sqn (BR) 13.8.87. To Boscombe Down to storage pending Tornado radar trials programme 27.6.88. To Warton 11.7.89. Sold to Barry Pover, flown to Exeter 23.12.92. Sold to Mike Beachyhead 2.97. Shipped to Cape Town, re-flown 1.11.01. Current with Thunder City fleet.

seat place in the prestigious and enigmatic Lightning. I had flown three air combat (1 vs 1) sorties on the LTF, all in the T-bird, all in one day with a total flight time 23 min. Yes, 23 min and three sorties. That actually comprised two 8 min flights and a 7 min one. Into the overhead for 8 min turning and burning then a split 'S' into the break to land. So that's why we pulled a bit of g in the circuit and expended a little pent up frustration!

'PIs were flown in various guises and had various nomenclatures which defined whether they were high or low, fast or slow, and the various start geometries that applied, like head-on or beam. The aircraft was positioned for an ideal geometric turn at a 0.5 Mach overtake to roll out for a firing position. Because it was all about geometry, it involved initial displacement. That needed to be calculated and adjusted, with relative speed calculations – literally timing the closure of the target over a certain time/distance – and then starting the turn in at a geometric 'key.' For instance, turn radius at 0.9 Mach was 4nm, hence, for a head on intercept (180 degrees) you drove for 4 miles displacement. Then at 12 miles, 40 degrees off the nose, you executed a standard rate turn towards the target, recalculating the geometry as necessary and correcting any errors in geometry if too tight or too slack to roll out perfectly. This had to be done while flying accurately, adjusting the radar antenna and 'gain' for an optimum picture and possibly climbing or descending at an accurate speed... both by day or night.

'By the way, I now find driving a car very undemanding because there's nothing going on in terms of switches or adjustment. I like playing with the satnav or doing something to keep the spare capacity utilised. Anyway, these sorties went on the authorisation sheets as GBD, D2B, Op2Hi etc, all pronounced phonetically. We flew them day in, day out either to a kill position, where we simulated and made the switches for a missile shot, or to a visual identification (VID) position. This was 200 yrd (break lock, generally) or 300 yrd astern, slightly offset and below. This was for shepherding aircraft that needed assistance or identifying intruders in UK airspace from QRA launches. We flew day and night formation, lights on and off, which was kind of interesting. For night lights out, you closed to a VID position then looked out. If it was a moonless night, or overcast at low level (1,500 ft minimum) you could often see nothing. You simply adjusted your position in azimuth, using the radar to keep station, and tried to distinguish either the glow from the jet pipes or some sort of silhouette from your new angle. It was all very challenging. The F-14 had formation strip lights which made night close very straightforward, although they had a scary, co-altitude join technique. This was because they stacked over the ship, so they had to maintain separation between formations.

'In short, that's how a Lightning pilot on a squadron in the mid to late 1980s learned his trade. He became adept at manipulating the radar picture and getting the best from it. He developed airmanship to an absolutely superior level. I saw that later at the TWU when it was clear in some areas I was thinking ahead of some, if not most. It manifested itself in what we called "capacity." We flew a "feel" aircraft with immense power, yet didn't really experience any of the glory days of the `60s and `70s because we had no fatigue to use. Therefore, when the restrictions were lifted and the jet's retirement from service was officially announced, it changed the nature of all the flying we could conduct. This was a whole new ball game. Lots of fighter affiliation at low level over land and sea. Over sea stuff was much more spirited because we weren't annoying anyone with the noise and some of it turned into virtually full combat on the deck. Normally the base height for combat was 10,000 ft in case you departed the jet and had to bale out. It was very silly but enormous fun and yielded some fantastic stories. Also, air-to-air combat (similar and dissimilar) and all the turning and burning you could wish for – really flying a fighter at last. Another bonus was that I was lucky enough to be selected and trained as an air combat leader. There were only five or so on the squadron. An ACL had to supervise all sorties involving combat or affiliation. I was involved in almost all the good trips. Marvellous!

'One of the early solo sorties on the LTF course was to take an F.3 over the sea and practise high speed turns and do a supersonic run. The turns represented a useful exercise because they were flown in full reheat until the 6g limit was reached. Then the nose position was adjusted until the max rate turn was sustained through the use of 6g. Going supersonic in the Lightning wasn't much of an event. There were no real physical cues, just a flutter on the strip speed indicator. But this type of sortie was pretty demanding fuel-wise. One student climbed into his F.3 – with only 7,600 lbs of fuel, as I recall – and found that the ventral tank hadn't been filled. Actually, the time when he noticed is subject to conjecture as he didn't say anything but got airborne and started the profile anyway. I can't remember how much turning he did or whether he went supersonic but he arrived back at base conspicuously early and had some explaining to do.

'Perhaps it was the fact that the Lightning and staff of the LTF were intimidating after flying the JP and Hawk, but you could be talked into almost anything by an Instructor. What I mean is that, for example, in the Hawk, perhaps at low level the Instructor would throw in a practice diversion, maybe a simulated flame-out or bird strike and it wasn't a drama because the jet had lots of fuel. Early on at the LTF I felt very far behind the jet so if an Instructor told me to do something I just did it and worried about the fuel when I could. That was a big mistake. I remember the boss of the LTF flying with me on one of my

A former 56 Squadron aircraft, F.1A XM181 is pictured on the flight line at Binbrook whilst serving with the resident Target Facilities Flight. Just visible are traces of 5 Squadron markings on the tail. Also worthy of note are the visible fairings over the (unused) gun ports. (Photo: Dick Lohuis collection)

final handling checks. He asked me to do a diversion to Waddington – not far away – and I simply set off without considering whether I had the fuel to come home. I didn't. Needless to say, it wasn't very impressive.

'There are hundreds of fuel stories. Some people are said to have experienced flame-out while taxying in, although I never saw this happen. Once, instead of following a tanker to Akrotiri in Cyprus, we staged via a series of flights down through Europe. On one leg through Italy, there was a very complex departure profile through a series of airways. This meant that we wouldn't get to height quickly so that we didn't have the fuel to get to our destination. What made it worse was that the weather was bad. The Lightning lacked a height read-out (Mode 'C') on its IFF so ground control didn't know what height we were at as we climbed. With the bad weather we simply climbed straight to our cruise altitude in the 30,000 ft region while reporting the necessary level-offs as ATC requested them. To ensure we didn't hit anyone in the climb we simply used the radar to clear the way ahead... I can hear the flight safety people cringing even now!

'Another time I was with a good friend on the squadron and we were doing medium level PIs (yawn!) and we had a tanker allocated to us. The rest of his "trade" all cancelled so he had tons of fuel to give away just for us... so we could do more PIs. After 4.5 hr he'd had enough and said: "One more top up and then I'm off home." That was fine by us but the full load would have left us up there alone for another hour. Instead, as the flight lead I said to the female (irrelevant, I know) fighter controller that we wanted to tank while pointed at Leuchars, that is, heading north. Although sounding rather confused, she obliged and when we were full of gas I said that we wanted to fly as high and fast as we could while heading home. This completely confused her but in the end she cottoned-on. So in "battle" (a mile or so line abreast) we simply plugged the burners in, accelerated to 1.3 Mach and started to climb. Soon the Mach number rose as I climbed to just over 1.8 for me. My mate had a less slippery jet so he started to slip behind. I managed FL680 and as I recall FL660 was the top level for controlled airspace.

'I called VFR on top going *en route*, which really confused the controller. I was just being daft because the jet was pretty much uncontrollable at that height. Stick inputs had very little effect so I was back talking to her almost at once. It was also important to keep your fingers on the engine relight buttons as a flame-out was highly likely. I understand that people had been higher and faster (much faster) but that was a first and last for me. A great experience: I could also see a bit of the Earth's curvature.

'Once, as a very junior pilot, I was tasked to take our most shiny jet to an air show as a static exhibit. This was always considered good fun as you didn't need to have the skill to fly a display and potentially make a fool of yourself. You could meet all your old mates and exchange lots of banter about your flying days. At that time we were struggling with unserviceability and it was deemed highly embarrassing if a jet didn't turn up to an event, particularly if 5 Squadron or a sister unit got their static exhibit into the air. It was late on a Friday afternoon and I was having starting problems. The "desk" was becoming frustrated with me and the engineers too. They tried every trick in the book to get me started. Basically, I was told it was the last clean jet and it was going, no matter what. The engines had a starter attempt limit of three on each engine because residual Avpin tended to collect in the system with potential hazardous results.

'"It had better work," was the comment from Ops when I got to my third attempt and heard the infamous 'wheee, phut' which signalled another failure. Despite the rule of three maximum, I was told to keep going and the inevitable happened. There was an almighty bang and the starter left the intake of the jet through the radar bullet, scattering debris all over the pan. Thank God, none of the ground crew were standing out front. Another jet was made available but only a not-so shiny one, and it leaked all over the air show's concrete all weekend!

'Still with air shows, on another Monday morning it was time to go home. There was a pristine USAF F-15 – I could have eaten breakfast off its jet pipes – parked next to me with equally pristine ground crew seeing it off. All aircraft had slot times to depart. Us Lightning guys didn't like to start too early so we didn't have to waste fuel. The F-15 pilot had no such problems and I recall the thing leaping smoothly into life and sitting there glistening for a full 30-40 minutes while the pilot looked at the obscure piece of junk (or history) parked next to him. The situation got worse when I went through a series of 'wheee phuts' on the second start-up, much to my dismay. There were no ex-Lightning ground crew people to help with the 'secret techniques' to make the thing start, so it was down to me. Calmly, I asked for a kettle of boiling water, unstrapped, climbed on to the aircraft's spine and opened the panels to access the Avpin filters. The Americans looked on in total disbelief. When the hot water arrived I removed the filter and flushed it. You could also hit it with a hammer to dislodge the muck. One engine was still running. I then thanked the ground crew and calmly got back in and started the errant engine with a look of nonchalance. I taxied out and met my departure time leaving with a flourish – a rotation take-off with the F-15 still sitting there...

'One day I was mooching around off the east coast near Binbrook when I spotted a Jaguar T-bird cruising back to Coltishall, or so it appeared. I had a bit of fuel so I thought I'd go and "sort it out." I turned in nicely behind it for a guns shot when clearly I was seen and this thing turned sharply into me. No snags, I thought, stupid Jaguar doesn't stand a chance. It kept turning and so

did I until I needed to get us up a bit and also get a bit slower if I wasn't going to embarrass myself. We ended up very slow, still at lowish level in what can only be described as a "scissors". I was unaccustomed to being held-off by a Jaguar, let alone in a scissors, and particularly a Jaguar that had wing tanks on but it soon became apparent that things were not proceeding as I'd planned. In the end I really took the jet up in full reheat and it was all I could do not to get shot down by the bloody thing.

'The Jaguar then scuttled off at low level, rather like a terrier that had been attacked by a bigger dog and sorted it out! I now had a dilemma: should I keep quiet or swallow my pride and call up and talk the fight through with the Jaguar pilot. I tracked him down and it was none other than Sqn Ldr Bagnall ("Baggers"), a man with thousands of hours on the Jaguar and ten times the talent I'd ever have. Unsurprisingly, he was a total gent and dismissed the episode as "thoroughly enjoyable, old boy." He'd been doing a check ride with a junior pilot and spied me rolling in, then took control and taught me a lesson. I bet the JP thought it was a hoot: stupid Lightning pilot!'

Of course, life with the Lightning was not always about flying. Many other non-aircrew personnel had cause to remember the aircraft with great affection. Robert Hilton was one and he was introduced to the Lightning at Binbrook, as he recounts: 'The Lightning and a posting to RAF Binbrook was my first, albeit short, operational tour. I was posted there in January 1977 as an LAC A Mech P at the tender age of 17. Engineering Admin put me into the Aircraft Servicing Flight (ASF). Our job was to do all minor servicing, modifications and rotation of airframes to and from storage. As I was so young they were loath to actually let me work on the aircraft so I was given a raft of odd jobs to begin with. Eventually, they relented and let me get my hands on the beast, under constant supervision, of course. I came to learn how easy (!) the aircraft was to service. Extricating bits from its bowels usually cost a lot of sweat and swearing before you had your prize in hand. Then would come the realisation that you'd have to get another one back in.

'Having spent some time on the engine team, I gravitated to the tank bay. Fuel leaks were something the Lightning was known for. If a Lightning didn't leak, it was probably empty. I spent many an hour scraping PRC (sealant) off various parts of the airframe with a plastic scraper, metal being a definite no-no. Once the offending area was clean (and I mean spotless) it was de-greased, then covered in yet more PRC. One of the worst jobs was re-sealing the boundary angles. These were situated inside the lower engine bay between the fuselage and the mainplane. Unfortunately, they were behind a rat's nest of hydraulic lines, making the removal and cleaning all that more difficult. Just to make it more fun, there were five bolts that screwed into the mainplane, which you had to lock-wire after you'd sealed it all up with PRC. It wasn't a half-hour job, that I can tell you.

'Being so complicated and difficult to maintain meant you had to keep your wits about you. When I worked on the engine team we had an aircraft on which an engine failed during final engine tests. It was due out on the line, so it was all hands-on to get it ready. While assisting, I inadvertently loosened a hydraulic line. A corporal pointed out my error and left it at that. The aircraft went out again and on start-up was covered in a fine pink mist of hydraulic oil. I thought the corporal had retightened the line and he thought I had. Oops!

'When I was working in the tank bay we were refuelling an aircraft which was back from storage. It had no engines and no radar bullet fitted. But it did have jet pipes. I was walking the wing, looking for leaks during refuelling. As I neared the wing tips it shuddered and rocked. I scurried forward and climbed down the ladder, remarking to my corporal that it was a little shaky. We watched it for a while but it seemed all right. It just stood there, not moving. Chalking it down to imagination, the aircraft was towed into the servicing slot and chocked. Off we went to lunch without another thought. When we returned we were working on a loose tank next to the aircraft when I heard the team chief shout: "*Help!*"

'I turned and saw a pair of legs dangling under the intake, which was higher than normal because the tail sat on the ground. The poor old chief was hanging on to the intake trying to get the nose wheel back on the floor. What's more, there was a rigger at the rear of the aircraft looking at the tip of his screwdriver, trying to work out how the hell it tipped the damned `plane over! We all raced to help and got the thing back on its feet and shoved a trestle under the tail to keep it there. Fortunately there was no damage (apart from pride) so all was well. The rigger said afterwards: "I put my screwdriver

T.5 XS419 enjoyed a fairly uneventful RAF career, the only significant recorded mishap being during December 1965 shortly after delivery when the aircraft was deliberately run off the runway during landing (following brake 'chute failure), striking various objects and causing a great deal of damage, resulting in a four-month repair programme. (Photo: Dick Lohuis collection)

into the first fastener and the aircraft just dropped like a stone."

'Aside from the servicing nightmares, the aircraft was a joy to watch in action. Being my first posting, it was many years later that I realised just how agile it really was even when compared to later generation aircraft. Sqn Ldr Brindle was the display pilot at the time and seeing him pull loops and figure eights in a short space became quite routine. The Lightning's general performance was startling. I remember seeing an F.3 intercept two Buccaneers during one exercise. The two Buccaneers split up and the Lightning pilot just nonchalantly followed one until he had him on the gun camera. He turned, there was a rumble of reheat and he was behind the other. I've never seen anything accelerate that fast before or since.

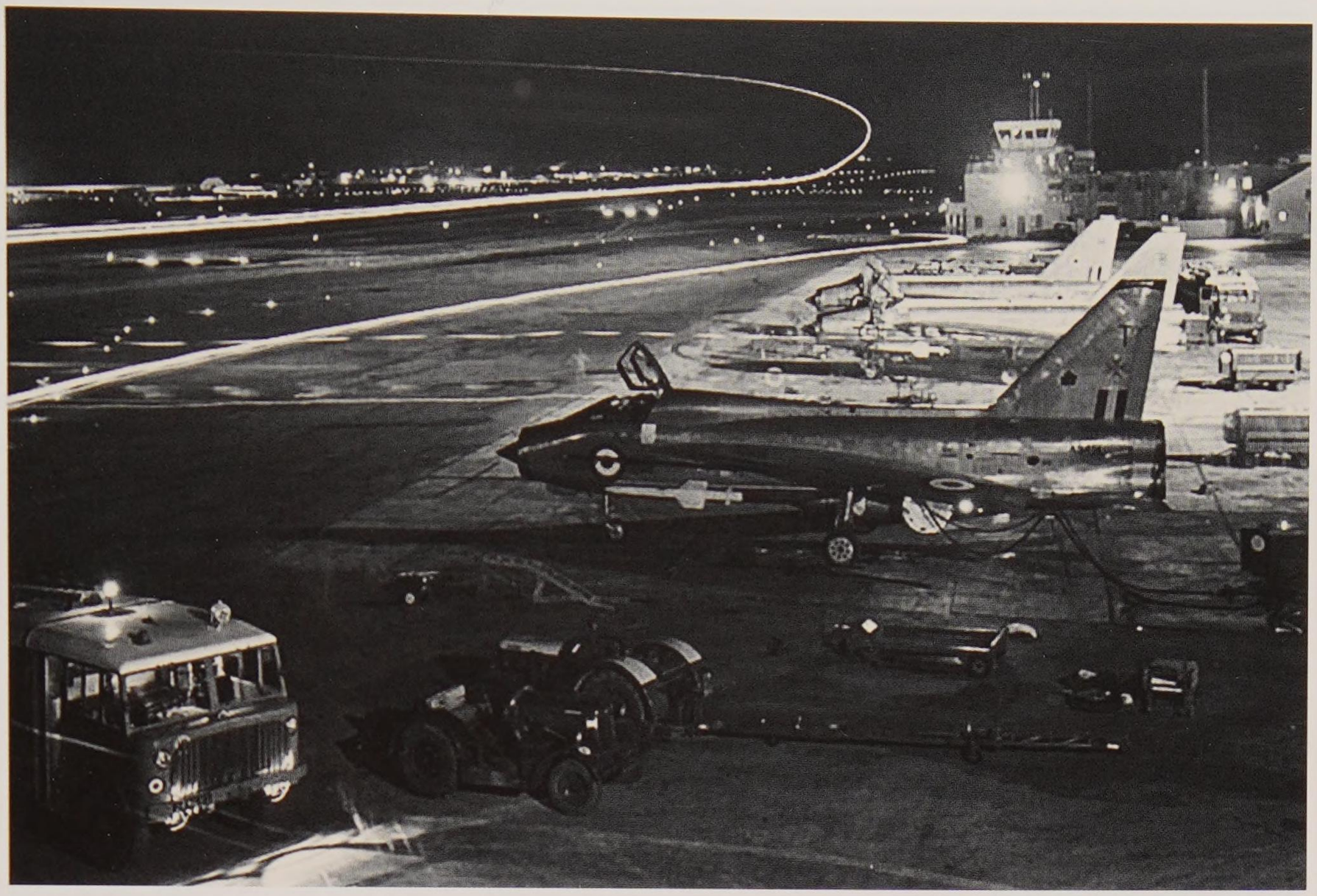
'Being such a hot ship, accidents did happen. During my tour, XS899 suffered a collapsed nose leg after a heavy landing broke off the shimmy damper – the Lightning hadn't got nose wheel steering. My abiding memory was the wheels-up landing of XR752 by OC 5 Squadron in September 1977. I was outside the hangar at the time doing a wing-walk looking for leaks when my corporal said: "Look at that!" I turned to the runway and saw it sliding along, port wing down. Once it came to rest the canopy opened and the pilot took off at great speed. Obviously, rumours were rife, but when all was said and done it was simple human error. I didn't hear what happened to the young man in the ATC caravan who should have been looking out for this sort of thing, but I imagine he got a stiff talking-to at least.

'The aircraft came into the hangar for repair and looked rather sorry. Fortunately, the damage wasn't terminal. Two portions of the ventral tank were holed (forward and centre) and the port wing tip was damaged. The parts were duly ordered and, when they arrived, unpacked. A silence descended upon the hangar when the forward section ventral tank had been unpacked. There was no provision for the Aden guns. The large ventral tank had originally been built without the guns. They were modified in at a later date. Unfortunately, it would seem that no spare tank had been modified. All the sergeants and chiefs, huddled around the packing case, whispering in hushed tones. Quite how they solved it I don't know. I had jumped the escape line and was posted to Scotland before the aircraft was repaired!'

John Blakeley was also posted to Binbrook and he recalls a particularly amusing incident during his time on Lightnings: 'It was a Friday afternoon at the end of a good flying week and the boss, Tony Winship, decreed that it would be a catch up-time for 5 Squadron's pilots and ground crew. As always in those good old Cold War days, we engineers went into a weekend knowing that we had to be prepared to generate aircraft for one of the many alerts or, even worse, the real thing. As usual we were struggling to ensure there were sufficient serviceable or recoverable aircraft to meet the response criteria.

'Binbrook airfield was still open and the miracle occurred: the AOG spare arrived for an aircraft we'd expected couldn't be recovered. All of a sudden we needed an air test to give us another aircraft for the weekend. I walked into the ops room to persuade the boss that we should fly one more sortie and keep a few people away from their weekend. I'd hardly got the request out before newly-promoted Flt Lt John Allison, who was approved to do air tests, had beaten everyone else to the draw with a shout of: "It's for me, sir." John and I remain very good friends to this day so I know he won't mind my pointing out that, as far as we engineers were concerned, he was one of our keenest and most competent pilots. That's not just the junior engineering officer talking but based on many comments from the boss and the flight commanders and was, indeed, proved in his later career.

'With nothing else to worry about the flight servicing was done in record time. John and I went through the air test requirements and the work that had been carried out. Very keen to fly, John left the ops room at speed to change into his kit. Less than a minute later, the heavy metal door between



A very unusual night photograph illustrating operations during a 5 Squadron exercise in Malta. The long-exposure light trails emphasise the proximity of the much-used visiting aircraft pan to what was the main runway (now the secondary runway) at Luqa. (Photo: MoD)

ops room and hangar opened very slowly with many grunts of pain and John staggered back in clutching his chest. His only words, addressed to me, were: "John, will it bend straight?"

'You've probably guessed. In his keenness to go flying he'd run full tilt across the hangar. Leaping nimbly over the towing arm attached to a parked Lightning, he caught its long pitot tube full in the chest, flinging him on to his back. Onlookers later said that he picked himself up and, obviously dazed, made a pathetic attempt to bend the pitot tube straight before returning to the ops room and confessing. In his defence, it should be said that the cover hadn't been fitted to the pitot. As it happened, there had been a good reason, but failure to fit covers was a frequent "offence" and a real bugbear. My initial reaction was that one of the engineers was going to suffer as much as John. Unlike John's ribs, the pitot tube couldn't be fixed and was scrapped. John was very gracious about the whole episode given that he was the one who'd been hurt and had lost the air test flight.

'The bent pitot tube was ceremonially presented to John on his departure to be an instructor at the Lightning OCU at Coltishall. But I've never seen it since, and John, who doesn't remember it, assures me he didn't retain it. As for the reason why the cover wasn't in place, the fitter who'd taken it off had just gone to get the test set and adaptor to fit to the pitot. He hadn't realised it might be subject to a high speed encounter with a keen pilot. Lessons learned all round!'

Not all Lightning pilots found themselves posted to Binbrook. Although the Lincolnshire base became associated with the Lightning when the type was gradually being replaced by the Phantom elsewhere, Fighter (and later Strike) Command's Lightning units were initially spread around the country. There were squadrons at Wattisham in the south, Leuchars in the north and Leconfield and Coltishall in the east. Further units were based in Germany, one was in Cyprus and another was at Singapore. Ian Hartley flew the Lightning with No.23 Squadron in the UK and with No.56 Squadron in Cyprus. He recalls some 'interesting' and occasionally humorous adventures as a member of the Lightning force: 'My abiding memory of my first Lightning sortie was the unbounded glee that I felt when starting up. Remember that we'd just come from 229 OCU flying the Hunter with its single Avon. Now, having started the first Avon engine, I was just overcome with unbridled glee thinking "and now I've got another... and both have reheat!" The anticipation of the sortie to come was fantastic. In the early 1970s Leuchars QRA was kept pretty busy with intercepts of Russian *Bears* and, at times, such scrambles were almost a daily occurrence. The *Bears*

XV328 was the penultimate Lightning T.5 to be manufactured and achieved an impressive 3020 flying hours with the RAF. This contrasts starkly with XV329 which managed only 902 hours over a period of just four years, thanks to corrosion which was caused whilst the aircraft was being shipped to Singapore. (Photo: Terry Senior).

No.226 OCU's T.4 and T.5 were undoubtedly amongst the most colourful of all Lightnings. Oddly, although the aircraft were obviously part of Fighter Command, the Lightning T.4s were given yellow 'trainer bands' (as illustrated), the T.5's receiving similar bands in day glow orange. The practice was abandoned in 1966. (Photo: Paul Tomlin)

F.Mk.1A XM214 pictured at Binbrook whilst serving with the OCU at Coltishall. This aircraft was displayed at the Paris air show in 1969, complete with Union flag on her tail. (Photo: Terry Senior)

were tracked virtually from take-off by Norwegian radar so that during the day we'd often get a couple of hours warning of the intention to intercept and whether it would be AAR assisted. But for sorties when the *Bears* were observed in the early hours of the morning, the controllers at RAF Buchan would keep quiet rather than disturb the QRA pilots' sleep. This often meant the QRA klaxon sounding at dawn. That meant there was no chance of that essential morning pee before getting airborne.

'There was one delightful occasion in 1970 when one of our 23 Squadron pilots was scrambled in this way and, much to his dismay, was told that his Victor tanker was already on its way. He was in for a long sortie. He eventually returned to Leuchars 2.5 hr later. His arrival on Runway 09, right in front of our crew room, was ragged to say the least. After some minutes we became concerned that he hadn't taxied back to our line so we called ATC to find out where he was. The conversation went like this:

ATC: "Glad you rang, we think he might have a problem."

Us: "Why, what is he doing?"

ATC: "Well, he landed okay and jettisoned his `chute on the ORP but then he came to a halt and has been standing on the end of his wing for the past five minutes."

Us: "Doing what?"

ATC, after a pause for the use of binoculars and then some considerable mirth: "He's pissing for England!"

'In May 1970, No.23 Squadron was on a month's detachment to Luqa and on the 25th a pair of us were working with HMS *Hermes* and when we were coming to the end of our sortie we were asked by the captain if we'd like to make an approach to the flight deck. My leader, a second tourist and therefore a god to me as the squadron's junior pilot, instantly accepted and called me in to echelon starboard for the approach. At this point alarm bells should have begun ringing. We then started our visual approach and, fortunately at the latter stage, rather than assiduously concentrate on my leader's wing tip I looked forward to see the flight deck, only to have a very intimate view of an apparently massive search radar. The captain of *Hermes* was not best pleased at my proximity to his expensive toy. Neither was I, and my god-like leader lost his aura as I dodged radar and island.

'My stupidest Lightning act was perhaps when I was at 226OCU. I had a temporary medical problem and was off flying for a few months so was re-coursed. My revised convex phase on No.1 Squadron which I'd already done before on my previous course consisted largely of receiving an F.1A to go off and do some GH [general handling]. On this particular day, I decided to see how high I could go but I hadn't thought it through at all. I climbed to around 40,000 ft, accelerated to about Mach 1.5 and pulled into a 45-degree climb. The stripped down F.1A (XM215) did the proverbial homeward angel routine and I soared upwards at an amazing rate. As I passed 70,000 ft I decided enough was enough and pushed the stick forward. It was at this point that my lack of forethought became apparent.

'The stick quickly came up against the end stop with no apparent effect on the aircraft's attitude. The problem was that the Lightning had very little forward stick authority. Combined with the rarefied air at this altitude, this meant that not much was going to happen. Meanwhile, I was still going upwards at a substantial rate. I didn't dare throttle back or cancel reheat as I feared the possibility of surge and flame-out. I considered rolling and pulling back on the stick but my IAS was now pretty low. I was afraid that I might spin so I had no choice but to continue with the stick held firmly against the end-stop and pray that gravity would eventually prevail. Eventually it did and I have a hazy recollection of peaking around 84,000 ft. I came back to earth a very shaken but much wiser man.

'One sunny summer weekend afternoon while on 56 Squadron in Akrotiri I was on QRA duty. We would have two pilots on duty, one on 10 min and the other on 30 min and so took it in turns to go to the aircrew feeder for lunch. On this occasion I'd gone first and while my colleague took his lunch I relaxed in one of the very comfortable armchairs in the crew room. The combination of a substantial lunch and the balmy weather had its inevitable effect. From the depths of my slumber I slowly became aware of a bell ringing. As consciousness returned I realised it was the red QRA telephone on the opposite side of the room. I leaped out of my chair only to discover that I'd the mother of all dead legs having been asleep with them crossed. I immediately fell over and had to crawl to the phone. Yes, the message was to scramble!

'The squadron's crew room was upstairs at the end of quite a long corridor. I had to crawl my way to the stairs and then down them, frantically trying to pump my leg back into life. I then had to drive the QRA wagon to the aircraft. My leg still would not co-operate but I managed to get to the aircraft where the ground crew were highly amused by my affliction. Once strapped in all was okay and I managed to get airborne inside the requisite 10 min. I cannot remember what I was scrambled against. I'm so glad that no-one was around to witness this particular operational scramble. The access track from the Q-shed to the runway was downhill, which often caught out and embarrassed the inexperienced.

'It meant that you rolled on to the runway with No.1 engine at idle (34 per cent) and No.2 at fast idle (65 per cent). There was then the huge temptation to slam both simultaneously to 100 per cent ready to select reheat. Because of the design of the shared intake and the initial throttle setting, the result was that No.2 immediately rocketed to 100 per cent, leaving No.1 gasping for air and virtually stagnating. It was quite a common sight to see inexperienced

pilots rolling down the runway for quite a distance before they were able to select reheat. Some gave themselves quite a surprise about the amount of runway they subsequently used.

'When the Turks invaded Cyprus in July 1974 they took over and closed Nicosia airport – our only diversion. We operated thereafter without a weather diversion and used the parallel taxiway as our crash diversion. Initially, we were not allowed to do this at night but by the end of the month our headquarters at Episkopi realised that we'd have to if we were to fulfil our all-weather commitment. But they insisted that everybody had to have a dual check first. These checks led to some near-disasters because of the narrowness of the taxiway, the lack of threshold lights and, above all, the side-by-side seating. I did mine with my flight commander, Henry Ploszek, and we had a very robust but brief difference of opinion about the accuracy of our line-up with the very hard-to-see taxiway before overshooting.

'Throughout my operational tours in the RAF I always flew at night with my cockpit lights as dim as possible. This all stems from an early night sortie on 23 Squadron with Ed Durham, one of the flight commanders. We were doing a standard intercept training sortie taking it in turns to be fighter then target. I was quietly flying along on a target run when Ed suddenly told me over the RT that my cockpit lights were much too bright. Somewhat startled, I looked around me to find Ed Durham looking down into my cockpit from a very large F.6 just above me. To this day when I drive at night I have my interior lights as dim as possible thanks to Ed Durham!'

The history behind this much-published photograph is unclear but it appears to illustrate one of many hair-raising fly-bys performed by Lightning pilots during their visits to Akrotiri. The extended airbrakes confirm that this is not a post- take-off picture but a very real and very low fly-by over what appears to be the taxiway! (Photo: Tim McLelland collection)

Lightning pilots earned a reputation for spirited airmanship and took every opportunity to demonstrate their flamboyant nature. Overseas deployments often provided an opportunity to do some discreet 'showing-off' away from official eyes, as illustrated by this very impressive (and very low) flypast performed in a T.5 over (or is it through?) Akrotiri. (Photo: Tim McLelland collection)

XS928 joined No.56 Squadron after having been returned to Warton by Belfast freighter, following an accident (the starter exhaust caught fire) whilst operating with No.74 Squadron at Tengah.
(Photo: Terry Senior)

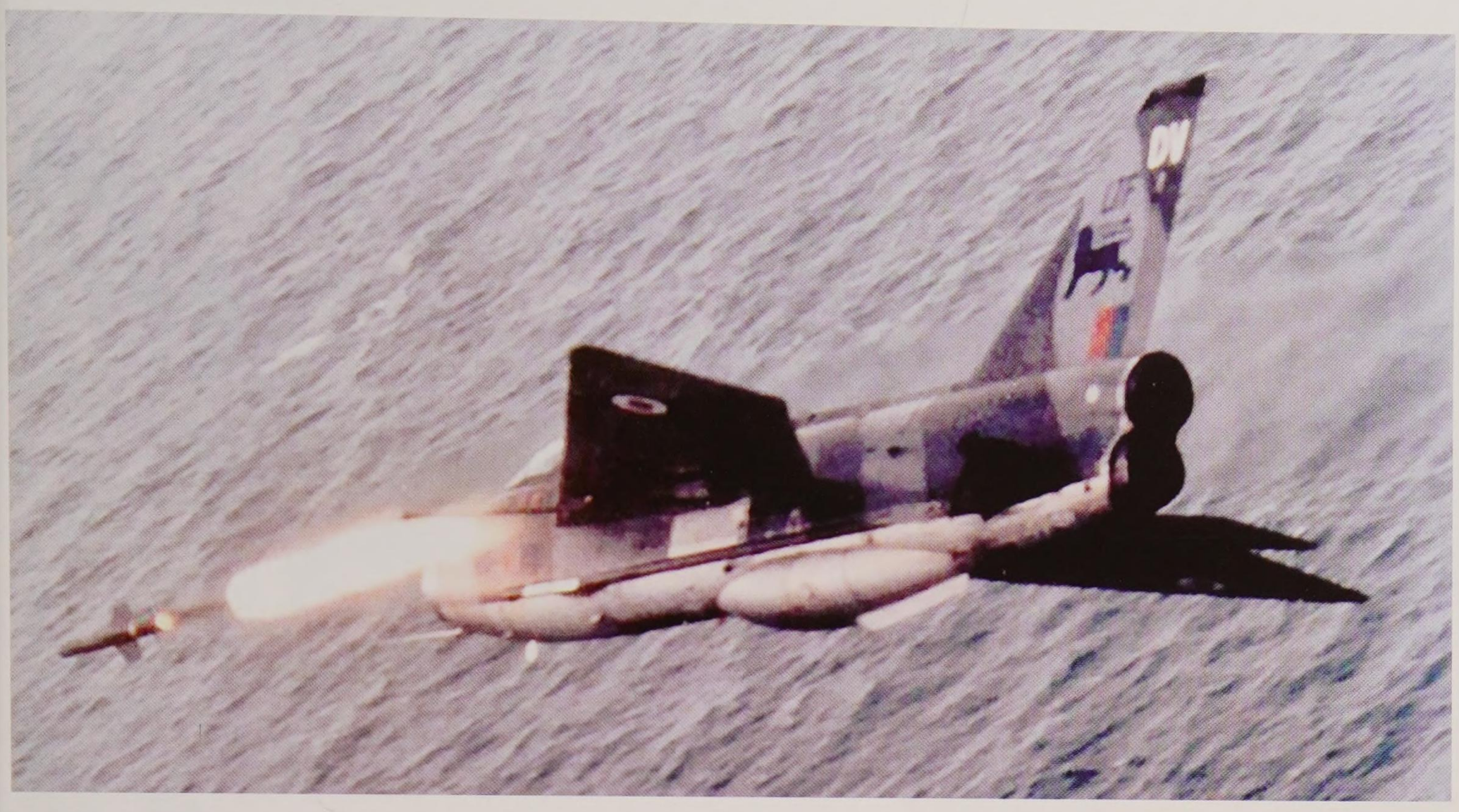
F.Mk.1A XM192 first served with No.111 Squadron prior to joining the OCU (as illustrated). This particular Lightning earned the distinction of becoming the subject of a famous model toy, when Airfix used the aircraft to provide dimensions for their hugely popular plastic kit which, forty years on, can still be purchased!
(Photo: Dennis Daws)

In celebration of No.5 Squadron's 21st anniversary, XS897 was repainted during October 1986 with full-colour national insignia, reminding onlookers of the Lightning's heyday when bare metal and bright markings were still commonplace. Pictured during an engine test, the intake is shrouded by a safety grille.
(Photo: Terry Senior)

Beautiful post-shower photograph of XS454 whilst serving with the OCU at Coltishall. A few years later the aircraft was assigned to Warton as a chase aircraft for the MRCA (Tornado) programme.
(Photo: Dick Lohuis collection)

Above and below: XM215 taxying-in after performing a flying display. A close look at the tail fin reveals traces of the aircraft's previous incarnation as 'C' of No.111 Squadron. Obviously one of the OCU's more reliable aircraft, XM215 was regularly used for display flying, and even took part in the 1969 Paris air show. Of interest is the white-painted dummy Firestreak missile, fitted for air display appearances (such as this one at Mildenhall, below). (Photo: Dennis Daws)

Magnificent photograph of F.1A XM182 in 'Firebirds' markings during 1963. (Photo: Keith Wilson)

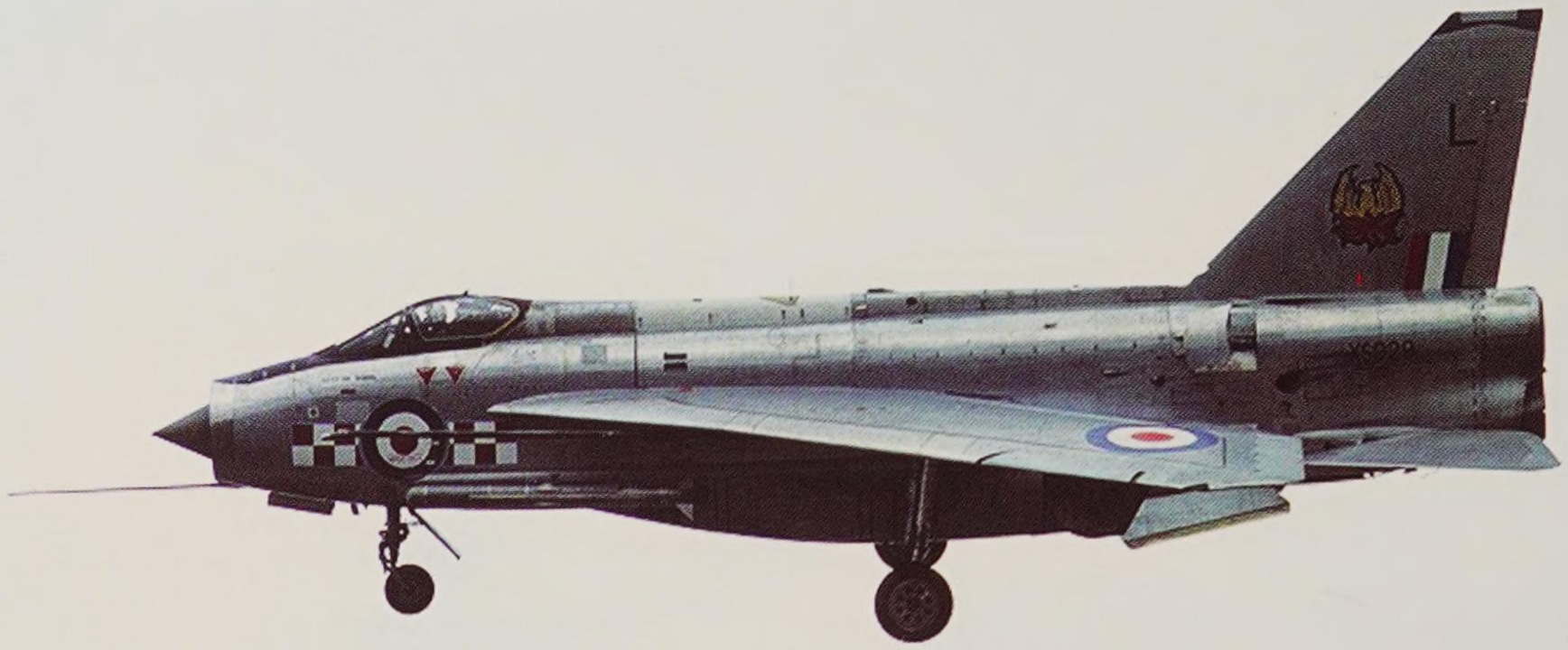


A rare photograph of a Firestreak launch from a T.5, captured during a Missile Practice Camp detachment at Valley. MPC launches were made against targets towed by Jindivik drones, over the nearby Llanbedr range in the Irish Sea. (Photo: MoD)

As with many unpainted Lightning airframes, the tail fin of XS417 reveals something of the aircraft's history with evidence of 56 Squadron markings still visible. The aircraft has survived and is now on show at the Newark Air Museum. (Photo: Terry Senior)

XR728 pictured at Binbrook prior to receiving her well-known 'Binbrook' markings and 'JS' tail code. (Photo: Terry Senior)

Pictured on approach to home base at Wattisham, F.6 XS929 subsequently went to No.11 Squadron at Binbrook but re-acquired 56 Squadron markings after retirement when the aircraft was placed on static display at Akrotiri. (Photo: Terry Senior)



Wintry scene at Binbrook as XP749 rumbles back to the flight line at the end of a sortie, brake 'chute dumped and canopy open for a breath of (cold) fresh air. The aircraft was later assigned to No.11 Squadron as 'BK1' and 'BK2' and used as a display aircraft for the 1984 season. (Photo: Terry Senior)

A beautiful early morning image of XR770 trailing her brake chute, resplendent in celebratory 5 Squadron markings. (Photo: Terry Senior)

Malta detachment 1966 with three Lightnings from No.56 Squadron on Luqa's visiting aircraft pan. The main runway is visible in the distance to the left. (Photo: Stuart Ross)

Although well-documented as the wearer of a 'shark's mouth' marking during 1984 and a black tail and spine by 1987, XS903 is pictured here as 'C' of No.5 Squadron during 1970. (Photo: Terry Senior)

Fighter Command old and new with two Lightnings from 226 OCU formating with two Spitfires from the Coltishall-based Battle of Britain Memorial Flight (which later moved to Coningsby). Not surprisingly, two Griffon-engined Mk.19 Spitfires have been chosen to keep pace with their rather more modern counterparts. (Photo: MoD)

XR750 wearing the markings of 'T' Squadron, 226 OCU, based at Coltishall, pictured during a visit to Binbrook. Unusually, this particular Lightning was never assigned to any of the Binbrook units. Originally manufactured as an F.3, it was later partially converted to F.6 standard but following another procurement shift it was re-modified to its original F.3 status. (Photo: Terry Senior)

A particularly rare photograph illustrating No.5 Squadron's MPC at Valley in 1966. Although the OCU's T.5s did have dayglow orange 'trainer bands' applied during 1965-66 whilst at Coltishall, 5 Squadron's XS451 appears to have been the only other aircraft to have been painted in this fashion. Note the live Firestreaks on the grass. (Photo: John Blakeley)

Interesting comparison of old and new camouflage scheme as a pair of 5 Squadron F.6s return to Binbrook from a PI sortie. (Photo: Terry Senior)

Right: XS933 braving wintry conditions at Binbrook. Withdrawn at the end of October 1987, the aircraft had achieved an impressive 3663.50 flying hours. (Photo: Terry Senior)

Left: A sight (and sound) which is missed by countless enthusiasts; Lightning F.3 XR718 getting smartly airborne into a tight right-hand turn to begin an aerobatic display sequence. Main undercarriage legs are just starting to retract. (Photo: Phil Elcock)

Below: A busy scene at Binbrook as a 5 Squadron F.6 (which appears to have lost its serial) waits to line-up on the runway, as a LTF T.5 comes in to land. With three very active Lightning units concentrated at just one base, Binbrook was almost always a busy airfield, much to the delight of aircraft enthusiasts who gathered at the crash gate from where this picture was taken. (Photo: Terry Senior)

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The Royal Air Force

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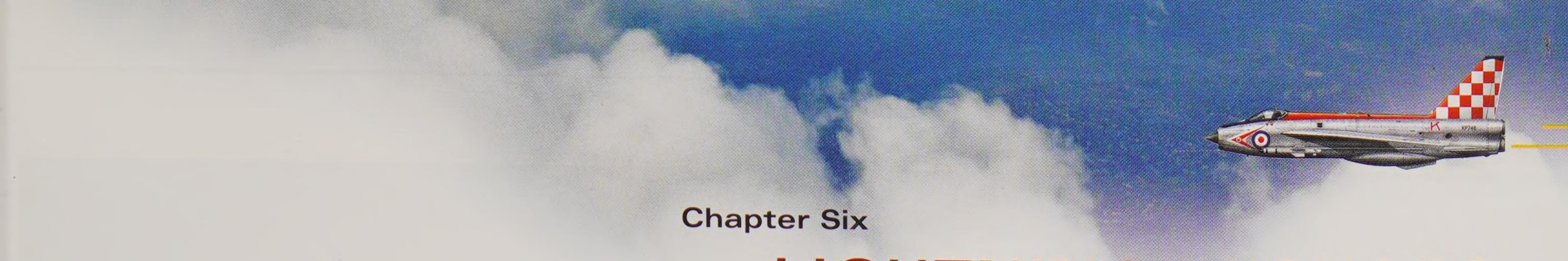
An evocative RAF recruitment advert from 1965, with the Lightning centre stage.

Line-up of 226 OCU Lightnings (T.5s and F.1As) at Coltishall during the early 1970s with T.Mk.5 XS458 at the end of the line. (Photo: Peter Arnold)

Pilots from No.23 Squadron returning from a sortie during 1971, illustrating the standard fast jet flying gear in use by the RAF at that time. (Photo: Ian Hartley)

Although XR718 ended her service life in dull, dark grey camouflage and toned-down LTF markings, in 1965 the aircraft wore one of the most dazzling paint schemes ever applied to RAF operational jets. No.56 Squadron adorned their entire squadron's complement of Lightnings with this eye-catching chequer-tail design when the Lightning F.3 was introduced in 1965. Sadly, RAF officialdom frowned upon such flamboyance and only a year later the markings were gone. (Photo: Keith Wilson)



Chapter Six

LIGHTNING MISHAPS

THE Lightning was hugely popular with every pilot fortunate enough to fly it. But it was demanding to fly and most Lightning pilots had more than a few 'interesting moments' during their time with it. Terry Kingsley was one. A former member of the world famous Red Arrows team, he first encountered the Lightning in Germany. He recalls: 'I arrived late for the Lightning F.2A and its central place in Cold War politics. It had been the first line of defence for RAF Germany and developed to fulfil that role. RAF Gutersloh, an old *Luftwaffe* base, was ideally situated for rapid presence at the border and our alert times for battle flight were well under the 5 min. The written requirement, I believe, was for two aircraft to be airborne in less than 5 min. Usually, only the primary aircraft went but we could be at the ADIZ in 5 min. The younger element could easily be airborne in less than 3 min. This 24/7 requirement was in part a tripartite agreement, plus an RAFG need, such that it should have been answered by a four-aircraft readiness. Not too close inspection allowed just two aircraft in the Q-shed with backup aircraft over at the squadron. Normal weapons carriage was two missiles with a full 30mm cannon load for the four Aden gun pack. Incidentally, it's noteworthy that in the event of a war that possibly only two sorties were anticipated before the squadron was retired back to the UK.

'Each squadron (92 and 19) operated in the frequent readiness state from revetments at opposite ends of the single runway on exercise. Some deft handling was required from ATC to make sure that aircraft approached to return to their own squadron's parking area and, more importantly, that the arrestor barrier was down at the approach end. This was quite an interesting contrast to today's "nanny state." Interesting too when you consider operation and recovery to opposite ends of one runway which at 7,280 ft was already short by Lightning standards. Availability of the barrier and the RHAG was not an option. I remember only one incident where the barrier was raised at the wrong end. This was perfect for the pilot who happened to have his arrestor hook malfunction in the air and deploy. Sod's Law says that'll be the day that ATC makes a mistake and has the barrier up and not down where it should have been. It took the top wire and did its job with only minor damage to what was a very strong aircraft. The RHAG installation was destroyed. For a master diversion airfield to go "black" with no landings possible caused quite a furore. I retired to the back of the ATC tower while those higher up the food chain considered their careers.

'On leaving the Red Arrows I'd wanted to go to Harriers, anticipating that my low-level experience would be useful in that role. The AOC persuaded me that the Lightning force was going to take on a low-level air defence role. As a sweetener I could expect to be the RAFG air display pilot for the F.2A. I'd not been in the air defence role since the late '50s and had much to learn. Having been a display pilot for several years, I found the Lightning quite a different challenge. The Red Arrows' Gnat could be displayed safely in very poor conditions. It had the capacity to carry out vertical manoeuvres with a

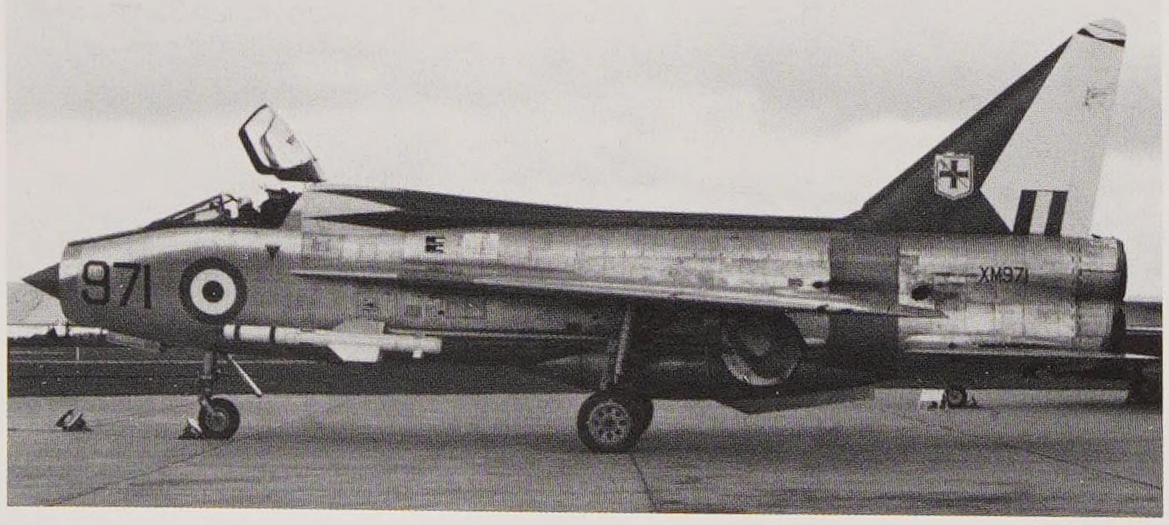
Failure of XM993's port main undercarriage leg (thanks to a casting flaw) led to this catastrophic landing accident at Middleton St. George on 12 December 1962. Pilots Al Thurley and Charles Gibbs escaped unscathed but the aircraft was written off. (Photo: Sir John Severne)

After a short stay with the Lightning OCU at Middleton St. George, T.Mk.4 XM991 was assigned to No.19 Squadron and remained with the unit until being withdrawn in October 1975 (becoming an airfield decoy at Gutersloh). (Photo: Dick Lohuis collection)

large margin of recovery when looping, such was its wing design. By comparison, the Jet Provost didn't have much performance to spare. A 1,500 ft loop on the way up would require all of that on the way down. The much heavier Lightning had a superb wing but could easily demand 3,800 ft on the way down when it only took 3,500 ft on the way up!

'The sight of a good friend of mine alongside the runway at Lechers, his aircraft arranged like a dart buried in the grass, said it all. What astounded me was that "first tourists" were superb in the complicated single pilot air defence role. I guess modern day video games must be responsible. As squadron QFI, I could try not to let operational single mindedness overpower basic airmanship and handling skills. There was always pressure to do things in the name of operations that you wouldn't even consider otherwise. This attitude was bound to bring me into conflict with the career minded and occasionally it did.

'The RAF instrument rating scheme had a long and painful gestation. In pursuit of operational effectiveness, junior pilots could easily find themselves projected to the front when unserviceable aircraft sidelined the leaders. My contention was that to scramble a very junior pilot on exercise, into weather that he wouldn't normally face, was poor supervision. Let them



T.Mk.4 XM971 served only with the OCU before crashing during January 1967. Debris from a damaged intake shock cone entered the engine intake leading to a flame-out, and both crew ejected safely, abandoning the aircraft in Norfolk. (Photo: Mark Swann collection)

start, taxi down the runway to demonstrate that they would have gone in wartime but cut it off there. We operated under NBC rules on exercise, full nuclear, biological and chemical constraints. This was tedious, time-consuming and limiting. We were required to wear a steel helmet in and around the revetments. But I couldn't concede that flying with a sharp loose object in the cockpit was good flight safety. I tossed mine on to the grass before departing. Not a good career move!

'The low-level change around occurred in the early 1970s and the low level defensive patterns were well established by 1971-72. What we were expected to do was considered the height of professionalism for a first tourist. We were to proceed to a given pattern, set-up a 3 min leg race track, hold there at 350 knots, make sure our timing was such that all patterns operated in unison with aircraft at the top of the pattern to the minute, exit the pattern when a bogie was sighted, deal with it and map read back to the pattern. But 250 ft in a Lightning at 350 knots is not a very comfortable airspeed. Besides which, the aircraft's gun sight line was inclined 7 degrees, putting a line astern gun shot well into the trees. We devised an attack profile that would allow a much safer solution. We also went on to include mandatory training in manoeuvres where knowledge of the aircraft's wing's capability was paramount. I did offer an inverted solution, which the boss declined! The speed of 360 knots was chosen to enable the pattern timing to be maintained. That was a race track of 3 min legs and a rate one turn at each end. You needed to rejoin the pattern to be on your gate time at the head of the race track so that all aircraft circled roughly together. Six miles a minute made it so much easier and it was a good loiter speed for endurance.

'Bear in mind that the Lightning's normal operational environment was radar-controlled under TACAN navigation. None of this was available in the low-level role. As a fall back I investigated the use of the forward missile radars. NATO forces were equipped with anti-aircraft missiles using their own radar sites. Although the air defence radar couldn't see you at low level, the missile radar could. If it could be established safely, you could get into the 40-mile window of the missile radars and be vectored on to incoming bandits. But you needed to be immensely comfortable at low level to take advantage of their limited coverage. While I was frequently amazed by the young pilots' abilities, you were well into specialised training for that sort of thing.

'I never professed to be much of a radar operator. The work load in the F.2A could get right up there but I did believe that with the rules of

engagement issues, gunnery was always going to be the deciding factor. RoE is usually the overriding issue in any conflict. A big part of the F.2A's job was visual identification (VISIDENT). At night or in cloud it was a time-consuming task. But – a big but – was that it put you very close to the target. So much so that a guns solution was, in my view, the most likely outcome. Consequently, a gunnery detachment was set up in Sardinia at Decimomannu. No.19 Squadron was the first to go and, with the minimal experience that the RAF then had with the F.2A and its sighting settings, it was terrible. When we went, the boss was well versed in what was required and I think five people gathered "ace force" standard. He scored very poorly until it was discovered that his sight settings were miles off, when his photo evidence was spot on!

'Back at Gutersloh, the "self help" model was necessary for the squadrons 'in view of funding weaknesses. Our bunker was provided courtesy of *Reichsmarshall* Goering, the weak link being the single large air filter. No.19 Squadron buried a trailer and the weight of the soil and grass destroyed it! Using the revetments meant that two aircraft had to make very tight turns into the space, putting great strain on the undercarriage scissors. This necessary link has a small pin at its weakest point. One pilot, Norman Barker, managed to land without damage to himself when this link broke, sight unseen from the ground. That he took the arrestor wire probably saved him, for Lightnings were prone to roll over during a one-mainwheel landings.

'I learned just how strong the F.2A was during a squadron nine-ship formation practice. In my usual position in the box right behind the boss, number eight managed to insert his wing under mine and hit the horizontal surface. The air loads were extreme and he eventually pitched up and over me, striking the wing tip and taking off the top of the fin. That was a canopy-to-canopy moment when two aircraft could easily have become one. Normal formation speeds were 250-380 knots, varying the height between 500 and 3000 ft. As he rolled over the top of me, he struck the top of my fin. This 40 ft lever delivered a very large blow to my spine. I pitched out of the formation to stop upside down, quite worried about my proximity to the rest of the formation. I transmitted that I was hit and looked in the mirrors to check the damage. There was a lot of it. The fin was canted over at the top. One elevator was bent downwards and heavily damaged, one aileron was crushed and there was loose metal high up on the fuselage. I forced the aircraft to roll upright and finished with the stick in the top right corner with all the trim and forward stick I could manage. We were in a left turn with about 10-15 degrees of bank. The aircraft was heavily out of trim and yawing steadily. I tightened my straps and transmitted a "preparing to eject" communication.

'The aircraft was still flying – quite well in spite of the damage. The major considerations were my inability to fly straight ahead but I chose not to try and fix that – or my speed. A low speed handling check was called for but as I slowed, the nose would rise ominously and there didn't seem to be enough pitch control to deal with that. The boss appeared on my right and checked the damage. I couldn't make the bale out area away to the north but was circling around the city of Gutersloh with lots of fuel. The vibration increased markedly with changes in airspeed, but I found that 190 knots was achievable. I could tighten the turn but not stop it but by chance I was in a pretty good orbit with a landing seeming possible. With fuel reduced to minimums, I eased out of the turn with the boss on my wing. We crabbed down for very irregular finals to an uneventful landing made at high speed. If anyone from Veterans Affairs is reading this, my back damage only gets worse. I'm afraid that 14g or more in a Lightning will do that to you!'

Eric Steenson, well-known as an accomplished air display pilot, was another with great affection for the Lightning. But he too recalls that flying the aircraft required a great deal of attention, as exemplified by a particularly hair-raising incident at Wattisham: 'I was always a "reluctant" Lightning pilot, wanting to go low-level but not air defence. All potential fast jet pilots at the end of the `60s were subjected to long delays throughout their training with "holding postings" in non-flying jobs being the norm. These usually came between basic and advanced flying training, again before weapons training on the Hunter and before the long-awaited operational conversion unit (OCU). Some had to wait longer than others and I was quite fortunate in finishing my basic flying training in July 1968 and starting my Lightning course at Coltishall in October 1970. Without doubt, the process did little to help develop the skills of inexperienced young pilots.

'I was also fortunate to have two spells of "holding" at Coltishall, the home of the Lightning OCU and having an opportunity to become familiar with the Lightning and its capabilities before embarking on the conversion course. Several aspects of the aircraft were immediately apparent. First, it was a noisy fast brute of a machine with a very impressive flight envelope. Secondly, the cockpit was small and cramped and, because of the structure of the canopy, the visibility was poor. Thirdly, it carried next to no fuel. Sortie durations for subsonic flights in the F.3 and T.5 were rarely longer than 45 min and if reheat was used for supersonic or high level flights then 35 min was more likely. Finally, the radar and weapons system was woefully inadequate and a challenge for most inexperienced first tourists. I was a fighter without a gun.

'Furthermore, the success rate in air defence exercises was higher at the OCU which had more two-seaters than the squadrons. This was not only due to the experience of the instructors but also to the fact that, with two of them on board, one could fly the aircraft while the other operated the weapons system. As the aircraft's role moved from high level to low level it was hampered by its inadequate radar system, poor missile performance and the lack of a radio altimeter. At 360 knots at 500 ft amsl the main altimeter had a 1,000 ft pressure error and would read 99,500 ft. However, at 200 knots the altimeter would read 500 ft. This latter problem, along with target fixation, contributed to the death of at least two pilots who flew into the sea while attacking slow moving targets at low level. A study of Lightning accident statistics reveals an attrition rate similar to that of the much-maligned F-104 Starfighter in service with the *Luftwaffe* in the 1960s and `70s.

'On completion of my training at RAF Coltishall I was posted to 111 Squadron (Treble One) at RAF Wattisham. There's no doubt that I wasn't about to become the local ace. That was left to colleagues like Cliff Spink, who went on to become an interceptor weapons instructor (IWI) with 56 Squadron and later Air Officer Commanding (AOC) 11 Fighter Group, and Tony (now Sir Anthony) Bagnall, who was 111 Squadron IWI at the time and eventually became Deputy Chief of the Defence Staff.

'Despite completing the OCU without any mishaps I lacked confidence and ability – not a good combination for a budding fighter pilot. However, I was declared fully operational after six months. I'd been through the full gambit of high level subsonic and supersonic intercept profiles, low level intercepts, air-to-air refuelling, 1 vs 1 and 2 vs 2 combat and the dreaded night "lights out" VISIDENTS. This last exercise and test involved intercepting a target at night with no navigation or anti-collision lights showing. If you were lucky the moon might be out as the radar would break lock at 200 yrd, the minimum distance at which a pulse could project to and reflect from a target. As I recall, the last stage to positively identify the target was flown by maintaining a 10-degree angle in azimuth and elevation until the target was sighted visually and then held in close formation. I was fortunate on most occasions when I practised to have some glimmer of light from the moon. My course colleague, who became the squadron QFI on 29 Squadron and who was immeasurably more capable than me, was less fortunate. He was killed one night when he collided with the target aircraft. Its pilot was lucky to survive the impact and his subsequent ejection.

'One of the impressive party pieces performed in the Lightning was the reheat rotation take-off. This involved taking off with full reheat, raising the gear before the limit of 200 knots, pulling 4g and climbing vertically to 5,000 ft or thereabouts. For whatever reason – no doubt accidents or near-accidents were among them – this manoeuvre was banned by the time I reached the squadron and was replaced by a "200 knot climb". This was all but the same as the rotation but with the 4g pull being replaced by a smooth transition from horizontal to vertical flight. The speed was chosen because if the forward retracting nose wheel was not retracted by 200 knots it wouldn't raise at all due to the air pressure. It looked very silly to be climbing at 200 knots or more with the nose wheel sticking out.

'To understand the quandary you have to realise that the Lightning F.3 could reach its take-off speed of 155 knots from brakes-on in 10 seconds, pass 200 knots in 13 and reach 360 knots by the far end of a 7,500 ft runway. As the event I'm about to describe took place nearly 40 years ago I may be a little hazy on some of the detail. My apologies to any witnesses or members of the subsequent Board of Enquiry who have a more accurate recall.

'In October 1971 I was briefed to be No. 2 in a three-ship formation to fly a 3 sec stream take-off for a 200 knot climb. I can't remember now whether it was a rehearsal for a families' day or the day itself. Although I'd flown a few 200 knot climbs before quite successfully, this was to be the first as part of a stream. We know much more about human factors in aviation now than we did then but no amount of agonising after an event can produce total recall of all your thoughts and actions. I do recall being concerned about not wanting to lose sight of the lead aircraft as well as being very aware of the nose wheel limitation. Whatever the cause, as I got airborne, retracted the gear and started my rotation, the aircraft sank and the tail hit the runway. This pitched it forwards on to the ground with the undercarriage now fully retracted.

'I was, of course, unaware of the spectacle being created behind me by 2,000 lbs of jet fuel being ignited by the reheats. I was on the runway at 180 knots with the gear up and no one to my knowledge had successfully landed the Lightning with the gear retracted. There had been several instances of the gear collapsing after landing and drogue deployment, but at much slower speeds. I also realised It would take one second for the canopy to deploy before the seat would eject, if I let go of the controls to eject. It wasn't a zero-zero rocket seat as later fitted to most fast jets so there was every likelihood that the aircraft would cartwheel before the seat fired. All these thoughts were running through my head while I elected to stay on the ground, closed the throttles and struggled to keep the aircraft on the runway centreline.

'The left wing tip was digging into the runway. I was using full right aileron and right rudder but as I slowed (seemingly only a little) both were becoming less effective in keeping me straight. Despite that, I took the centre of the barrier at 135 knots, lower than I should have been, and promptly pulled the whole paraphernalia out of the ground. The over-run was replaced by a ploughed Suffolk field. The aircraft came to an abrupt halt with the top cable of the barrier embedded in the fin and some 18 in worn off the left wing tip. I motored the canopy open and climbed out over the side. I had probably forgotten any post-landing or shut-down checks and was definitely in a state of shock.

'The guy who was number 3 in the stream also had an interesting take-off but he managed to avoid the debris. The airfield was closed for six weeks for runway repairs and the squadron deployed to Honington where I joined them after my Board of Enquiry and subsequent severe reprimand. I became the first to land on the new runway with the squadron boss in the T.5 after completing a further operational check. I continued my relationship with the Lightning until July of the following year when my application for a second operational tour was rejected. That probably saved my life as the list of friends and acquaintances having accidents and incidents or even dying in the aircraft continued to grow. No doubt, it would have been only a matter of time before I joined them. These days it would probably be called risk management!'

Former Typhoon test pilot Craig Penrice spent 18 years in the RAF flying a variety of aircraft including the USAF's F-15 Eagle. An experienced Lightning pilot, his most memorable encounter with the Lightning was certainly not an enjoyable one, as he explains: 'A good pilot is sometimes defined as one who has the same

number of take-offs as landings. I guess the events of 19 September 1985 involving XS921 and myself made sure I can't claim to be a good pilot. The trouble is, once you've managed to accumulate one more take-off than landing in your log book, it's nigh-on impossible to redress the balance. Try as I might, I've been unable to come up with a foolproof plan.

'This isn't the normal Lightning story of: "There I was, short of fuel..." or "There I was gunning the brains out of a blind Phantom crew...." Instead, this is about one of the less-publicised times when things didn't go quite as planned but thanks to the wonderful invention of Sir James Martin I'm at least in a position to tell the story of how I became one of nearly 5,000 people he's placed in the category of "not-so-good" pilots. The day started normally. This was my second day back at work following a wonderful 10 days of leave spent in a cottage on the west coast of Scotland opposite Skye. Well-deserved leave, I might add, as I'd just returned from the annual six-week detachment to Akrotiri in Cyprus for the squadron's APC [armament practice camp].

'It was just before 17:00 hr when I took off as number two of a pair of Lightning F.6s on the way to undertake our normal bread and butter training sortie of medium level PIs [practice intercepts]. We would each take it in turn to act as target (the bad guy) and fighter (the good guy). The fighter controller on the ground at RAF Boulmer would vector us apart by about 40 miles then turn us towards each other. The fighter would then have to use his AI23 radar first to detect the bad guy. Then, through some nifty mental gymnastics, he would have to work out the target heading and altitude before making corrections to his own course to achieve the correct point in space from which to start a turn to end up in a missile firing "cone" behind the target.

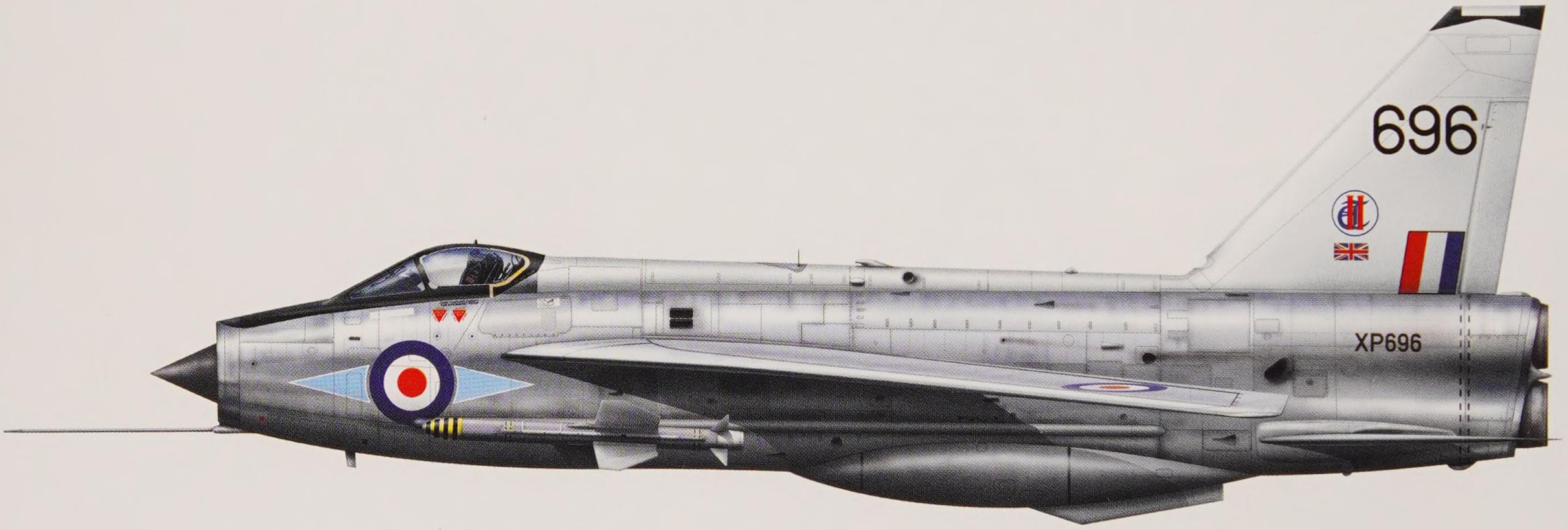
'The sortie went pretty much as we'd planned it. We were almost down to recovery fuel and I was acting as the target aircraft pilot. Once the flight leader had completed his turn to end up behind me and was closing in to finish his attack, I started a gentle turn to the left so that we were heading back more directly towards Binbrook. Things went downhill from there...

'Having moved the control column to the left to roll into the turn, the aircraft thought it would be a jolly good wheeze if it kept moving the stick of its own accord. Despite my best efforts the stick continued to move all the way to full deflection left. The aircraft duly did as it was told and kept rolling left. As it passed the inverted position, the nose started to drop. Very quickly I found myself in a near vertical spiral dive but not a spin. The ailerons had gone to full deflection. Normally they were limited to half deflection with the gear up. The aircraft was rotating very quickly. As I was going downhill the speed was also increasing rapidly. At this point I did a number of things.

Pictured with No.92 Squadron at Leconfield during 1967, XN769 became the last surviving example of the Lightning F.Mk.2 in the UK, visible for many years outside the LATCC at West Drayton. Sadly, it was sold as scrap by the MoD and not offered for preservation. (Photo: Dick Lohuis collection)

LIGHTNING F.6, XS903/AM, 5 Squadron 1984

C/N 95249 ff D. de Villiers 17.8.66. 5 Sqn (A later C and A) 16.3.67. Displayed at Paris show 1967. To 11 Sqn (later BC) 14.10.80. To 5 Sqn (AM later AO) 19.8.84. To 11 Sqn (BE later BA) 16.7.87. Final flight to Elvington 18.5.88 with 4054.35 hours. To Yorkshire Air Museum.



LIGHTNING F.3, XP696/696, 226 OCU 1970

C/N 95120 ff J.L. Dell 2.7.63. CFE Binbrook 15.1.64. To Boscombe Down for Red Top trials 16.2.66 to 5.6.67. To Warton for full F.3 modifications. To 226 OCU (696) 18.6.70. Solo display aircraft with white painted spine and tail 1974. On loan to 111 Sqn and 29 Sqn 1974. Storage Wattisham 8.10.74. 1186 hours. To dump 4.75. Sold as scrap 10.75.

LIGHTNING F.3, XP746/K, 56 Squadron 1965

C/N 95174 ff D. de Villiers 26.3.64. 56 Sqn 15.4.65. Withdrawn for repairs, returned to 56 Sqn (K) 2.6.65. To 60 MU then 111 Sqn (J) 5.8.70. Wattisham Storage Flight 1.10.74. SOC 28.11.74 with 2170 hours. Stored on airfield and scrapped 1975.

LIGHTNING F.6, XR770/AA, 5 Squadron 'Red Tail' 1980

C/N 95235 ff R.P. Beamont 16.12.66. Displayed SBAC Farnborough show 1966 in Saudi markings. To 74 Sqn (coded C) 26.9.66. To Tengah 1971. To 23 Sqn (L) 22.5.72. To 56 Sqn (D) 30.6.75. To Binbrook ASSF 17.7.76. To 5 Sqn (B later A) 8.6.78. To 11 Sqn 28.7.80. To 5 Sqn (AA) 26.11.80. To 11 Sqn (X) 2.3.83, 5 Sqn 21.4.83, 11 Sqn 12.5.83. 5 Sqn (AA later AJ then AA) 13.7.83. To 11 Sqn (BN) 4.88. To LESF 11.5.88, LTF markings (JS). 4022 hours. Dismantled and removed to Lacebt 17.7.88. To Waltham then Gainthorpe. To 5 Sqn for display, Waddington.

Pictured without missile armament (but with missile rails attached), F.Mk.3 XP702 wears the markings of No.56 Squadron during 1975, shortly before being assigned to the LTF (although it is believed that the aircraft wasn't actually used by the unit at that time). (Photo: Dick Lohuis collection)

The first was to make a call on the radio. I said: "I've got a very bad control restriction." At the same time, I swapped hands on trying to move the stick and used my right hand to switch off the auto-stabilisers in the hope that they were the source of my problems. The auto-stabs effectively had the job of smoothing out the ride for the pilot at high speed around the transonic region, where, but for the auto-stabs the aircraft would exhibit a pronounced nodding tendency.

'After what seemed like an eternity, but was just 3 sec, the flight leader came on the radio and asked: "Is it better now?" I answered: "No" about four octaves higher than my normal voice. Immediately after that I ejected. There was no thinking about it or time to prepare. The situation was obvious: the aircraft was rotating rapidly and going downhill like a train. I was now flying in cloud, speed was increasing. The one action I could think of to make it better had done nothing. So I ejected.

'I can remember pulling the lower ejection handle with my left hand while simultaneously throwing my head and shoulders back against the seat with as much force as I could manage. I also remember trying to grab my left wrist with my right hand to secure it against the wind blast. This latter action proved somewhat futile. The next proper recollection I have is sitting facing backwards on the cabin floor of the Wessex rescue helicopter. The side door was being closed and I was feeling very, very cold. Nothing, else, just very cold. This was about 50 min after the ejection. I wish I could fully describe how cold I felt but in all the times I've told this story I've never been able to satisfactorily describe the intense, all-encompassing cold I felt then.

'Some interesting things are worth a mention at this point. This was a Thursday; on the Monday of the same week the ejection seats of the entire fleet of Binbrook Lightnings had been modified. The PLB (personal locator beacon) was supposed to be activated automatically during the normal ejection sequence at the point when man-seat separation occurs, rather than having to be manually operated. This was considered to be a great improvement if the pilot was incapacitated as the beacon would still be operative. In addition, with the beacon transmitting from 10,000 ft, its range could be increased and transmission was more immediate than previously. The PLB was stowed in a pocket in the life jackets we wore all the time. Auto-activation was achieved by means of a sticker strap incorporated into the existing lanyard which attached the dinghy pack to the life jacket. As man separated from seat the lanyard pulled taut and a cam rotated the power switch of the beacon to the "on" position.

'The only drawback of this arrangement comes under the heading of "old dogs and new tricks." Previously, there'd been no big deal when getting out of the aircraft if you stood up and hadn't disconnected the dinghy lanyard. You simply felt a tug (and a bit of a fool), which reminded you to undo it. The same was not the case now. Everything was still true except that the PLB would now be set off and a transmission would be going out on the distress frequency until you scrabbled around and managed to extricate the beacon from its pocket and switched it off. This in turn resulted in three things. There was some work for the safety equipment fitters who had to rebuild the jacket. The initiation of a rescue scramble for the nearest helicopter unit until they'd obtained confirmation through the ATC network that the beacon they had observed near Binbrook was in fact an inadvertent activation. The third thing was much embarrassment for the pilot concerned.

'In my case, the rescue helicopter team members at Leconfield were in the process of walking out to their aircraft for the umpteenth time in the week. No doubt they were also cursing those idiots at Binbrook who were incapable of extracting themselves from an aircraft without alerting the safety coordination system. However, it soon became apparent that the signal from this PLB was much stronger than previously experienced. By the time the rescue crew were in the helicopter and in radio contact with their control centre they were getting the message that this was a real scramble. This probably saved me between 5 min and 7 min, time that would become invaluable.

'I said earlier that this was my second day back at work following some leave. It was mid September and pleasantly mild. The average temperature in the North Sea was around 13 degrees C, about as warm as it ever gets. Our rule book stipulated that when the sea temperature over the area of operation was less than 10 degrees we were to wear an immersion suit. In practice, this meant that for about eight months of the year all the air defence squadrons in the UK were flying in bulky immersion suits. This temperature cut-off was not just an arbitrary figure. It was based on medical study and experiment to measure body core temperature decay over time in different ambient conditions. This was then compared with expected rescue times and a realistic figure for survivability versus cockpit comfort was established. This figure of 10 degrees was based on a reasonably healthy individual having been ejected from an aircraft, immersed in water before climbing into

A typical scene at Binbrook's runway threshold as No.5 Squadron's 'AR' streaks in at the end of another sortie. (Photo: Terry Senior)

his dinghy and waiting for about an hour for rescue. Sure, he'd be cold, but nowhere near "life-threateningly" hypothermic.

'So here I was, flying around on this lovely autumnal afternoon in my normal flying suit under which I was wearing thin cotton long johns, a T-shirt and green roll neck shirt. I was a reasonably healthy individual who'd been ejected from an aircraft and immersed in water and that was about as far as it went. That was why I was feeling so incredibly cold sitting on the floor of the helicopter. I'd been in the water without an immersion suit for almost an hour. Another interesting thing had happened in addition to the PLB implementation which had contributed to speed up my rescue.

'A Nimrod was on its way back from the Baltic *en route* to Kinloss. On hearing my beacon going off it was diverted to the scene of the search. With their more powerful and sensitive homing equipment and their speed the Nimrod crew were able to locate me before the Wessex was halfway. The Nimrod then dropped a large beacon in the water beside me that allowed the Wessex to come directly to me instead of having to enter its normal search pattern based on homing to locate by PLB. Again, this probably saved another very valuable 5 min or 10 min.

'In addition, my flight leader added his part to the search in an amusing way. After our conversation just before my ejection, having had no reply to his subsequent transmissions and on hearing my PLB going off, he immediately dived down below the cloud to a height of about 2,000 ft. As he broke out of the cloud he saw what he described as a huge water eruption. He then spent the rest of his limited fuel orbiting around this area looking for me in the water. What he failed to realise was that I was still above him floating down on my parachute. The `chute is set to deploy automatically as the seat descends through 10,000 ft and it takes about 15 min to float the rest of the way down to the surface. I often wonder what would have happened if we'd passed close to each other or even if he'd impaled me during his search for me. It would have made interesting reading in the accident report.

'When I was found in the water there was evidence that I'd done a number of things despite having no memory of the time between pulling the handle and sitting in the rescue helicopter. I'd inflated my life jacket, undone the parachute harness, removed my oxygen mask and, for some reason, taken off my gloves. I'd managed to partially separate myself from the dinghy pack that forms the seat portion while in the aircraft. This is normally dropped on a lanyard during the parachute descent by undoing two clips, one on each side, that rest around the small of the back when you are hanging in the `chute. Because of my injuries I wasn't able to undo one of the clips. This meant I was still connected to the parachute through my lanyard to the dinghy pack and in turn to the harness. Effectively I had the biggest sea anchor you've ever seen. With the exception of removing the gloves, all the things I'd done were part of the frequently-taught descent drills, which we were required to practise on a regular basis.

'The medical theory is that, despite having no memory of these events, I was actually conscious, at least for the initial part after leaving the aircraft. But as I got colder and colder the brain is very clever and it blacks out the bits it doesn't like to save you the nasty memories. During my recovery the doctors offered the suggestion that hypnosis would probably be able to rekindle these memories for me. I declined their offer!

'Meanwhile, back in the helicopter, apart from feeling very cold I felt that my arm was a bit sore and my leg was a bit achy too: nothing agonising, just a bit uncomfortable. I had an overwhelming sensation that this was a very bad dream, one you know you're sure to wake up from soon but until then it was still very realistic. The trouble was that no matter how much I wanted to, I simply couldn't awake from this dream.

'My injuries were quite significant and were almost entirely due to the high speed at which I ejected from the Lightning. I had started the turn at 27,000 ft doing Mach 0.8, eight-tenths of the local speed of sound, which at that height equates to about 350 mph of real wind. Post-crash simulation showed that by the time I left the aircraft I was doing about 0.95 at 18,000 ft, or more importantly, battling an excess of 500 mph of wind blast. My right arm had flailed and been broken against the elbow joint as it smashed against the ejection seat. Similarly, my left knee had been pushed outwards by the control column as the seat left the aircraft. This allowed it to be flailed and broken against the joint outwards rather than forwards. I received some significant grazing burns to my neck from being thrown around as the parachute harness deployed. My face looked like I was the Michelin Man, all puffed up and swollen. The whites of my eyes were totally red. Finally, I'd dislocated my left index finger, the theory being that I just wouldn't let go of the ejection seat handle but that its 300 lbs weight finally won.

'When Binbrook got the message that I'd ejected, the boss and his wife went round to break the news to my wife. They waited until they'd received a message from the helicopter that I was on board, cold but alive, but there was no word on how alive I was. My wife knew as soon as she saw them getting out of the car that I'd suffered an accident. She spent the next hour waiting until I got carried off the helicopter, remembering the incident of a wife in a similar position who went to meet her "injured" husband only to find out that he was dead. Needless to say, she appreciated my wink to her as I was carried off the chopper. Once I was in the medical centre at Binbrook they started to determine the extent of my injuries and began the process of warming me up again. They soon realised that the broken elbow and knee would require orthopaedic surgery, but the acute hypothermia needed arresting before I was stable and could be moved. Later that evening I was airlifted to the RAF Hospital at Ely, Cambridgeshire.

'The Sea King helicopter that flew me, my wife and a medical team to Ely had been scrambled just after the Wessex from Leconfield. The Wessex doesn't have the capability to perform a night hover rescue with no lighting

on the surface, whereas the Sea King does. The Rescue Coordination Centre had scrambled the Sea King as a precaution in case the Wessex had been unable to locate me before darkness fell. Thankfully, the Wessex and Nimrod combination got to me in time.

'To conclude this tale, the accident investigation people were never able to locate the exact component that would prove their theory of what caused the control column to move on its own to full left. In fact, they found no more than a couple of skips-worth of bits. They were able to reproduce the symptoms I had experienced with an aircraft in the hangar. Two hydraulic jacks mounted on the ailerons themselves power each aileron, and each jack has a port to each side of the aileron to move it up or down. When a control is demanded in one direction, there's an open circuit that slowly drives the jack assembly back to a neutral, closed position. In this way any demand from the pilot in the opposite direction to that originally demanded will immediately result in a jack force being available to move the aileron.

'However, if in the short period when the open circuit is catching up, something falls into the gap, the system sees that as a continuing demand for more aileron to roll the aircraft. What baffled the engineers before they tried it in the hangar was how one jack could overpower the three other unaffected ones. The answer comes from the fact that the affected jack is in the process of supplying a demand, whereas the others are merely in a follow-up mode.

'This wasn't a new accident cause that had just been discovered, as similar accidents had happened on a Jaguar and a Buccaneer and possibly others. It was just an accident cause that was quite well forgotten. The only way to prevent it would have been to encase the aileron PFCUs [powered flying control units] in some form of shroud to prevent any loose articles from getting into them. So what was this loose article and where had it come from? The answer is that nobody knows. The last recorded work on the PFCUs themselves was quite some time before the accident and they were able to identify many migration routes from all over the aircraft to the PFCUs, so it proved impossible to positively determine the direct cause.

T.Mk.4 XM968 proudly wearing the markings of No.92 Squadron, with traces of a previous spell with the OCU still visible on the tail. This particular aircraft was assigned to BAC during 1964 in support of the TSR2 programme, flying chase sorties from Boscombe Down.
(Photo: Paul Tomlin)

'An interesting precursor to this story came when we were in the line hut checking the aircraft Form 700. The flight leader asked if I would mind if we swapped aircraft. We'd been allocated aircraft with tail codes BL and BA. The latter (XS921) was the boss's allocated aircraft but BL was "his own." As this was his last week on the squadron before being posted to RAF Valley, and subsequently the Red Arrows, he wanted to fly his jet as much as possible. I had no objection to swapping, so we made a quick call to the ops desk so they could note the change in authorisation sheets that we'd signed to record the proposed details of the sortie. It wasn't until weeks after the accident while some physiotherapist was torturing me that I suddenly remembered this event. I quickly asked for a telephone and tracked down my illustrious leader at RAF Valley. When I told him what I'd just remembered there was a very sheepish silence and shuffling of feet at the other end. He said: "Er... well, I had hoped you wouldn't remember that." I wasn't fussed but whenever I get the chance I make sure I tell everyone about his embarrassment. There have been several instances since then when I've been asked to swap aircraft but my answer has always been an unequivocal no!

'My return to flying took the best part of a year. I needed ten nuts, bolts and screws to fix my knee and another 13 to fix my elbow. That operation took seven hours to complete. I wasn't operated on until a week after the crash as I was so cold and weakened from the hypothermia. In that time, despite eating all the hospital food they brought me, I lost 26 lbs in weight, such was the drain on my metabolism warming me up again. The medical verdict was that ten years earlier I would almost certainly have lost my arm, so severe was the damage to the elbow joint.

I wasn't out of the woods just yet. I'd not been able to raise my wrist or stretch my fingers since the accident. The doctors were hoping this was due to pressure on the nerve from the broken bones that would recover once the bones had been arranged back into their correct positions.

Beautifully evocative picture of two Lightning F.Mk.2As from No.92 Squadron, about to get airborne from Gutersloh. The rear aircraft (XN973) is the 'Boss's aircraft' suitably adorned with a crowned "King Cobra" marking. Sadly, XN793 was subsequently scrapped although XN730 has survived and is on display at Gatow. (Photo: Paul Tomlin)

'It turned out that the nerve had been severed and would never recover on its own. I had to have a nerve transplant to fix the damaged one. Some nerve fibre responsible for the sensation in my inner arm was removed and inserted to replace the damaged portion of the radial nerve. Recovery from this type of damage is a slow process, with the nerve having to re-grow down its sheath and reconnect with muscles that have been unused and atrophied for some time.

'It was a long battle to get back into the cockpit of a Lightning. Many hurdles had to be surmounted to prove that I was safe and able to operate one of Her Majesty's aircraft once again. Some of my determination to do this came through overhearing two doctors discussing my condition and saying something to the effect that "he'll never fly again." In addition to a great deal of physical support and encouragement from everyone on the squadron, I'd have been at a complete loss without my wife's devotion and attention during my recovery and beyond. For this I will be forever grateful.'

Although the stories of Lightning mishaps are probably too many to count, the most famous is one which involved a pilot whose first (and only) Lightning flight was completely unintentional. Taffy Holden has earned a place in British aviation history as a man who – entirely by accident – found himself airborne, alone in a Lightning, as he recounts: 'First I should explain that I was a qualified pilot, even though I was an RAF Engineer Branch officer. I joined the RAF as an apprentice in 1943 and gained a cadetship to university. There I read mechanical engineering and learned to fly on Tiger Moths with the University Air Squadron. On graduation, I was given the option of continuing with an engineering career or following a General Duties (Flying) career. I chose the former and the Air Ministry at that time considered there was merit in allowing me to qualify to "wings" standard as a pilot. This was based on the belief that an engineering officer with a pilot qualification could more easily see the pilot's point of view in aircraft maintenance matters. I also thought this was a very good idea. I qualified on Harvards but my early engineering duties only allowed me to keep in flying practice on Chipmunks. While I was at Kinloss, I managed to get checked out on Oxfords and on occasions assisted a qualified test pilot to air test twin-engine Neptunes.

'My only jet aircraft experience was as a passenger in the second seat of a Javelin T3 and also in the "rumble" seat of a Canberra. In my service, one of my postings took me to 33MU Lyneham. There, as the CO of a civilian-manned aircraft storage unit, I had Canberra, Meteor and Lightning types, which were gradually being prepared for despatch to various flying units. When the Meteors and Canberras had been cleared, the powers-that-be decided that the MU should close after the last Lightnings had been despatched. Up until the last Canberra, I had a qualified and current test pilot on my staff for those aircraft, but he wasn't a current Lightning pilot. When a Lightning needed test flying, I had to call for any available pilot with a current test pilot rating. Usually, I'd find one who could be spared within a 24- or 36-hour period.

'XM135 was being prepared for despatch to a target facilities flight, but over a period of weeks it had been giving no end of trouble. Each time it was being flight tested, the pilot found that on the initial few yards of a take-off run, the inverter, supplying power to the primary flight instruments, would cut out and the stand-by inverter would have to cut in. This was clearly an unsatisfactory state of affairs. Electricians were using every trick to establish the cause, each time thinking they'd removed, replaced and tightened every likely component. With nothing out of order, they would seek another test flight.

'It was a Boscombe Down pilot who next attempted to fly the aircraft. He found the same problem and refused to fly it until a more positive explanation could be determined. Back to the drawing board. Electricians decided to devise some tests which might isolate the fault and indicate roughly which component was at fault. They intended to ask the next test pilot to switch in and out parts of circuits, using trailing wires from the likely circuits to temporary switches in the cockpit and to do so before and after each few yards of a simulated take-off run when the fault manifested itself. The temporary wires from internal circuitry required the cockpit canopy to be removed and in this state the aircraft was made ready for another air test. Being a pilot, it was easiest for me as CO to request the services of a qualified test pilot wherever I could find one. But for the next test on XM135, no pilot was available for at least another week. With my unit closing down, many civilians being made redundant and a clearance timetable being upset with this "rogue" aircraft, there was much tetchiness and irritation among my staff. The intended Boscombe Down pilot, knowing I was a pilot, suggested I might try the test myself. He suggested out-of-use Runway 36 as I would only be using 30 or 40 yrd at a time. He suggested using a Land Rover to communicate with Air Traffic Control and to get their clearance for each

movement of the aircraft. However, there was one minor problem remaining. I'd only sat in a Lightning cockpit once before and had no idea how to start its two Rolls Royce Avon engines! The engine trades foreman gave me a 5 min briefing on how to do this and XM135 was towed out to Runway 05 on 22 July 1966 for my electrical tests.

'It was by way of extraordinary good fortune that my engine foreman explained that, although I wouldn't be needing reheat, it needed the throttles to be pushed past a reheat "gate" and that you had to feel for the gate keys behind the throttle to unlock. My only other knowledge of the Lightning was what I could remember from pilot's notes. At each test flight by the qualified pilot, I'd be in ATC with a copy of pilot's notes should he need any aircraft figures to be relayed to him. One or two figures stuck in my mind, namely that the undercarriage had a maximum speed before it should be retracted. I had an even vaguer figure of about 150 knots for a landing speed. Some extra knots would be required for each 1000 lbs of unused fuel but I didn't need to bother with any such figures for the test. I was correctly strapped into the cockpit and seated on the *in-situ* parachute and ejector seat. After starting the engines and holding the aircraft on the brakes, I did the necessary preliminaries for the electrical checks in the cockpit, checking the notes I'd scribbled on a notepad now lying on the coaming in front of me.

'All seemed ready for the first test and I indicated to the Land Rover to obtain ATC clearance for use of the short 30 or 40 yrd of runway. Holding the brakes, I gradually opened the throttles to about 90 per cent. My feeling at the time was the unexpected heavy vibration of Avon power held against the brakes. I did a quick check of the temporary electrical switches and circuitry lights, then released the brakes. That initial punch from the thrust was quite remarkable. I moved the expected 30 to 40 yrd before I throttled back and applied the brakes. So far so good. I made some notes, altered some more switch positions, noted the on/off lights and prepared for the next test. This was done in a similar fashion. I was leaving the "fault" diagnosis to my electrical staff who would have to interpret my notes.

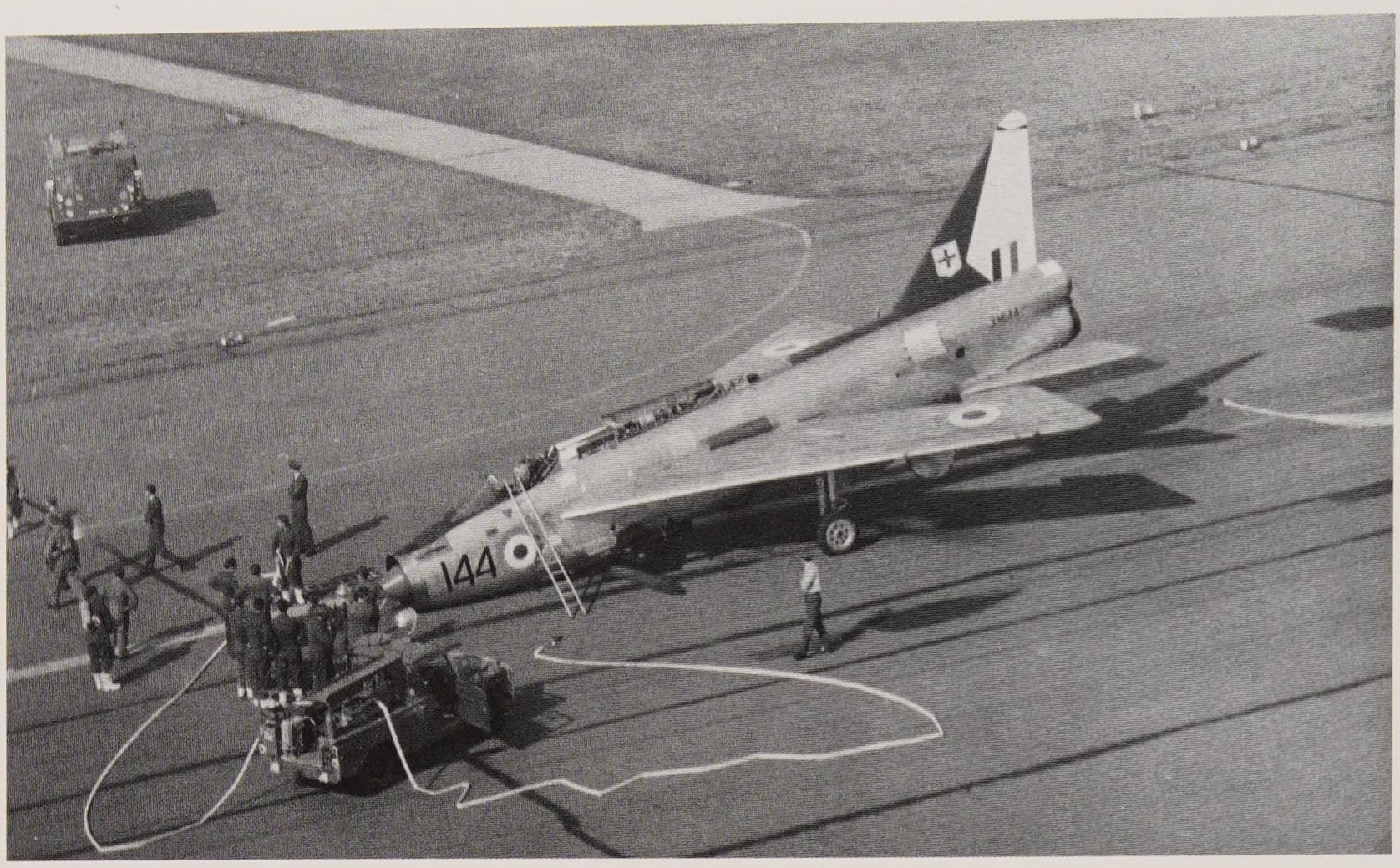
'I needed to do one more test and ATC had noted that I'd only used about 100 yrd in total. They were quite happy to clear me for a similarly short distance. ATC had also been holding up a fuel bowser and trailer with 3,600 gal of fuel for aircraft awaiting refuelling and they decided to allow it to cross the runway. On opening the throttles for that final test, I obviously pushed them too far. I misinterpreted thrust because of the unexpected heavy vibration and they got locked into reheat. Yes, I did use some expletives. But I had no time to think of getting out of reheat. In front of me were the bowser and trailer which had just crossed the runway from right to left. My thoughts were to make sure I was missing them by sufficient margin. No, I couldn't steer to clear them. Reheat takes you in a straight path like a bullet out of a gun. The time between finding myself in reheat and just missing the bowser was less than half the time taken to say this sentence.

'Before my thoughts could return to getting myself out of reheat, I was gathering speed and about to cross the main duty runway where a Comet had just passed on its take-off run. I had no time to look for reheat gate keys. My eyes were on what next lay ahead: the end of the short Runway 07 and just beyond was the small village of Bradenstoke which I just had to miss. There was no chance of stopping, none whatsoever. I'd gained flying speed – that's what reheat is for, short sharp take-offs – and I had no runway left. I didn't need to heave it off the runway because the previous test pilot had trimmed it exactly for take-off and only a slight backward touch on the stick. I was gathering height and speed. Then my thought was to get the speed back in case I should damage the undercarriage. Incidentally, I couldn't have raised the undercarriage. The ground servicing locks were in place for safety reasons. With only clear blue sky in front of me, I could then search and feel for those gate keys.

'Yes, I found them and thanked my lucky stars that my engine foreman had quite incidentally told me of their location. I was soon able to get the speed back to (I'm guessing now) about 250 knots. My next thoughts were about keeping Lyneham airfield in sight and wondering where the Comet I'd missed a few seconds ago had got to. Then I asked myself: should I eject and if so, where and when? No, I couldn't. The safety pins were in the ejection seat and safe for servicing, not for flying. My only alternative, then, was to attempt a landing, but how do you interpolate or extrapolate Tiger Moth, Chipmunk or Harvard flying to a two-engine, 11-ton beast like the Lightning? After regaining my bearings, a little composure and, simply by observation, making sure that the Comet had been warned away, I decided I should attempt a landing on the duty runway and direction.

'I was trying to combine all my limited flying experience into a few minutes of DIY flight "training" on a Lightning. It wasn't easy but I must admit that some of the rudiments of my proper flying training and flight theory were coming in useful. I needed to get the feel of the aircraft if I was to get it back on the ground. My first approach was ridiculous. I could tell that my speed, height, rate of descent and even alignment weren't correct. My best plot was to go round again but this time make sure my throttles were well below the reheat position. A second approach was no better. Some aspects were better but as the duty Runway 25 is on the lip of an escarpment, with a valley floor beyond, my rate of descent took me below runway height. I found myself adding power to get back to the right level. More power also meant more speed and I was trying to get to something like 150 knots for

A beautiful image of No.92 Squadron's flight line at Gutersloh in 1976. Of interest is the contrast in paint schemes applied to the Firestreak missile with one weapon carrying old-style white paint, and another suitably camouflaged in dark green. (Photo: Paul Tomlin)



Undercarriage problems plagued the Lightning for many years. XM177 suffered a rather undignified return to Middleton St. George on 29 September 1964 when the nose gear refused to extend (the shock absorber stop had sheared), and pilot FO Ian McFadyen was obliged to make a suitably gentle landing, lowering the nose onto the runway at 80 knots (having first dumped the canopy and ventral tank over the sea). (Photo: Sir John Severne)

landing. But the uncoordinated attempt was becoming a mess so I abandoned it, took myself away on a very wide circuit of Lyneham and decided to land in the opposite direction. This, I thought, would give me more time to get the "feel" right. If I made a mess of the landing, I'd over-run the runway and just drop (crash) into the valley beyond. In that direction, with a messed up landing, I'd have no fear of crashing into Lyneham village.

'The long final leg of this approach gave me the thinking time I needed. Gradually, I got the feel that speed, alignment, rate of descent, height and approach angle were better. I plonked it down at about the right position off the runway threshold. But I just forgot I was in a nose-wheel aircraft and emulated my best three wheelers in a Chipmunk or Harvard. The result was that I crunched the rubber block which encases the brake parachute cables. I was down but then I had to stop. I obviously knew the Lightning had a brake parachute, but where was the 'chute lever, button or knob? There, I found it, marked "brake `chute." I pulled it and could then look ahead and concentrate on keeping straight and somewhere near the centreline. I hung on to the brake lever. I wasn't slowing as much as I'd like so I just kept up my hand pressure on the brakes. I had about 100 yrd of runway left when I stopped. Even then, I didn't know that the brake parachute had dropped off as soon as it was deployed because the cable had been severed as a result of my super tail wheel three pointer.

'XM 135 was towed back to the hangar and I was taken to see the medical officer who gave me some pills to calm my nerves. I felt reasonably calm because I'd almost killed myself on five occasions in that 12 min flight, yet I'd miraculously survived. What's more, I would see my wife and young family again. Two or three times in that same 12 min I thought I wouldn't. My only priority was to save my own skin, rather than the non-insured loss of a Lightning Mk.1A. The minor damage to the aircraft was repaired with a new set of brake shoes and a new rubber `chute block.

'As a memento, I kept that rubber block. One day it might be returned to XM135 at Duxford. Although the tests I did and the ensuing flight didn't immediately provide a reason for the initial electrical fault, my electrical staff, with additional assistance from English Electric, Samlesbury, eventually did. Apparently, in early versions of the Lightning there was to be a ground test button fitted into the standby inverter circuit. It was never fitted to the Mk.1A but the wires were left in the looms. It was one of these redundant wires which shorted on to the UHF radio as it moved on its trunnions when the aircraft nudged forward on take-off. Who'd have thought I'd risk my life to find it in the way I did? There was an Inquiry to find out what had happened and why, and to make recommendations for it never to happen again. As the unit CO I was responsible for my own actions as well as those of my staff. I wasn't acting against any orders in the Flight Order Book which I religiously kept up to date.

'But those orders didn't cater for engineering officers doing investigative type checks on Lightnings. They were later amended. After the unit inquiry I had to go up in front of the Commander-in-Chief. That was when I thought my career would be placed in jeopardy. I even thought that my coveted "wings" would be taken from me. I had no idea how the incident was being regarded by Command or, indeed, Air Ministry. But, as I stood in front of Air Marshal Sir Kenneth Porter, he read the proceedings, asked me if I agreed with his view that with my limited flying experience, the test would have been better left to an experienced and current Lightning test pilot. I did of course. He then told me to remove my hat and sit down while he proceeded to tell me about some flying incidents in Mesopotamia in the Middle East. I was thankful that nothing more was to become of the incident and that I still had a job to do back at 33 Maintenance Unit, Lyneham.

'I coped with all the official communications regarding the incident but I was unprepared for the release of the story to the public. I had had very little experience of working with the press, certainly none with radio, TV, national and world press. I had no training on how to deal with their quest for news. My Command Headquarters suggested I went away on leave before press releases were made by the Air Ministry. This I did and took my family off camping to Jesola, in Italy. Imagine my complete surprise when, on the first day while I was on my way to find some ice, someone shouted: "Hello, Taffy, I've just been reading about your Lightning flight!" The world seemed a very small place.

'Returning to the UK, I was overwhelmed to find that the incident was still front line news. People wanted to write articles in newspapers, books and magazines. There were interviews on TV and radio and underhand attempts to hear my account of what had happened. Having admitted that I'd made an unwise decision to do the ground tests, I decided that the unwanted publicity I'd attracted was in no way going to be for financial gain. I steadfastly refused offers, although for a two-page article in the *Sunday Express*, I requested the editors to make a contribution to the RAF Benevolent Fund. Despite prompts, no money was ever handed over and I became very disillusioned with all news media. Some friends thought I'd gained reward for an article in *Mayfair*. It was written without my knowledge and authority, but because it was factually correct, I had no redress from the Press Complaints Board. Nonetheless, I was extremely annoyed.

'Some years after the incident, my hidden fears of high speed flight came to the surface and I had to spend two periods in hospital. I hadn't come to terms with the emotional side of the event. To return to my wife and family after five close encounters with death was indeed a miraculous experience.

Brake 'chute failures were surprisingly rare and on most occasions the Lightning could be brought to a stop without parachute retardation. XR760 is pictured taxying-in at Binbrook complete with her unopened brake 'chute which had 'candled' upon deployment. (Photo: Terry Senior)

But I hadn't been honest with myself to accept it as such. I needed psychiatric help. I could recall the technicalities of the flight without any hang-ups but was unwilling to talk about that emotional side of the ordeal until I was given drugs to bring those emotions to the surface. That was a rewarding experience and it gave me a much better understanding of people who might need the same kind of help after similar unfortunate occurrences.

'I'm now retired and living with my wife in Cheshire. Apart from being an active DIY plumber, carpenter, electrician and handyman, my main pastime is involvement with family history. My inadvertent flight is still very vivid and I needed little prompting. Over the intervening years, I've received many letters and reminders from people I did not know who were praising my efforts to return myself and aircraft back to the ground safely.

'Yes, I've basked in some glory when accounts of what happened have been re-told in social gatherings. I've never sought publicity but whenever it became impossible to suppress it, I've had to live with it. I enjoyed my career in the Royal Air Force, but not because of XM135!'

A final line-up prior to disbandment, No.92 Squadron's full complement of Lightnings at Gutersloh, with suitably-arranged tail codes which read 'The King Cobras XV' (their local rugby team!). (Photo: Tim McLelland collection)

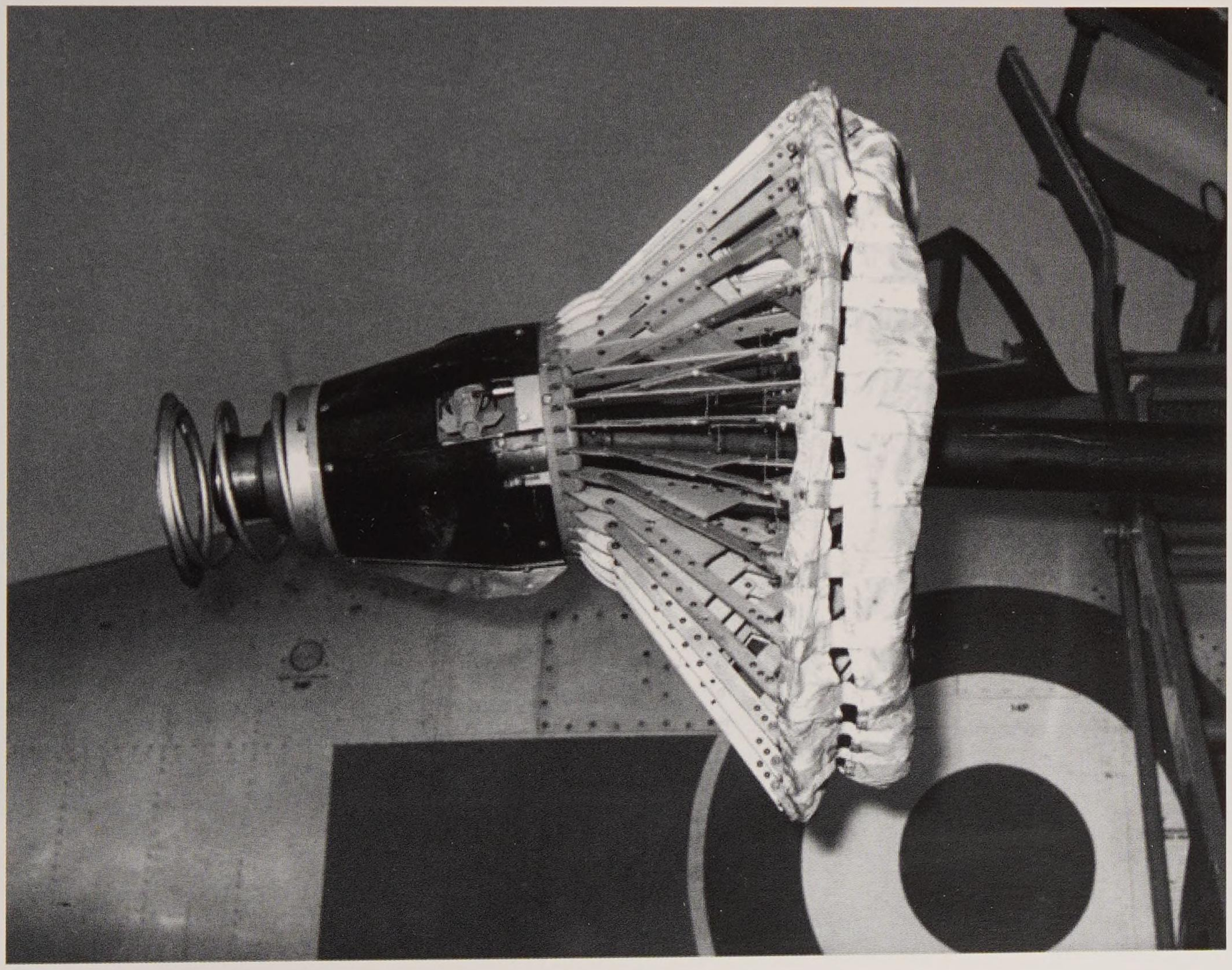
An interesting rear view of F.2A XN781 trailing her brake 'chute after landing at Gutersloh. Although the Lightning's brake parachute was stowed underneath the rear fuselage, the attachment and anchor point was above the fuselage, and the associated cabling was threaded around the two jet pipes when the parachute was repacked. Although seemingly complicated, the parachutes usually functioned very reliably.
(Photo: Paul Tomlin)

B

Landing the Lightning was a challenge for even the most experienced pilot, and some arrivals were fairly spectacular. This image taken at Binbrook captures XS452 suffering at the mercy of crosswinds. Despite the alarming nature of the picture, the aircraft recovered safely.
(Photo: Alan Southcombe)

Not all Lightning mishaps took place in the air or on the runway. F.1A XM188 suffered brake failure on 21 June 1968 at Coltishall, running into hangar offices with one engine jammed at 80 per cent thrust. Although the aircraft was written-off, the pilot (Arthur Tilsley) escaped unscathed, climbing onto the office roof.
(Photo: Tim McLelland collection)

Atmospheric shot of a 19 Squadron F.2A touching down at Gutersloh. The Lightning's high pressure tyres were designed to be incredibly tough but they were capable of withstanding only a few landings. A sizeable proportion of used tyres regularly found their way to weapons ranges, used to create targets. (Photo: Paul Tomlin)



Aerial refuellings didn't always go to plan. Pilot John Walmsley was forced to make an emergency landing at Leconfield after the drogue basket broke away from a Victor tanker during a sortie in 1967 and remained attached to his Lightning's refuelling probe. (Photo: MoD)

XS416 back in business as 'AZ' of No.5 Squadron, following her undignified departure from Binbrook's runway on 19 July 1984, when the undercarriage partially collapsed on touchdown. Following the accident, the T.5 fleet flew with landing gear locked down until the source of the undercarriage problem could be identified and rectified.

XM135, the aircraft in which Taffy Holden made his infamous one-off flight from Lyneham, is now in the hands of the IWM at Duxford and has been repainted in the markings of No.74 Squadron. (Photo: John Davidson)

F.2A XN773 pictured shortly before take-off from Gutersloh. This particular aircraft was assigned to Rolls Royce at Hucknall for Avon 210/211 development work, prior to being converted to F.2A standard. (Photo: Paul Tomlin)

Excellent view of Gutersloh's QRA shelter (the 'Q Shed') with two fully-armed Lightning F.2As at readiness. Ahead of the open shelter doors, the track linking the shelter to the runway is clearly visible. (Photo: Paul Tomlin)

An unusual photograph showing a pair of Lightning F.2s from No.19 Squadron formatting with a Super Mystere from the AdlA. Squadron exchanges often included a brief photographic rendezvous for the squadron's albums.
(Photo: Steven Beeny collection)

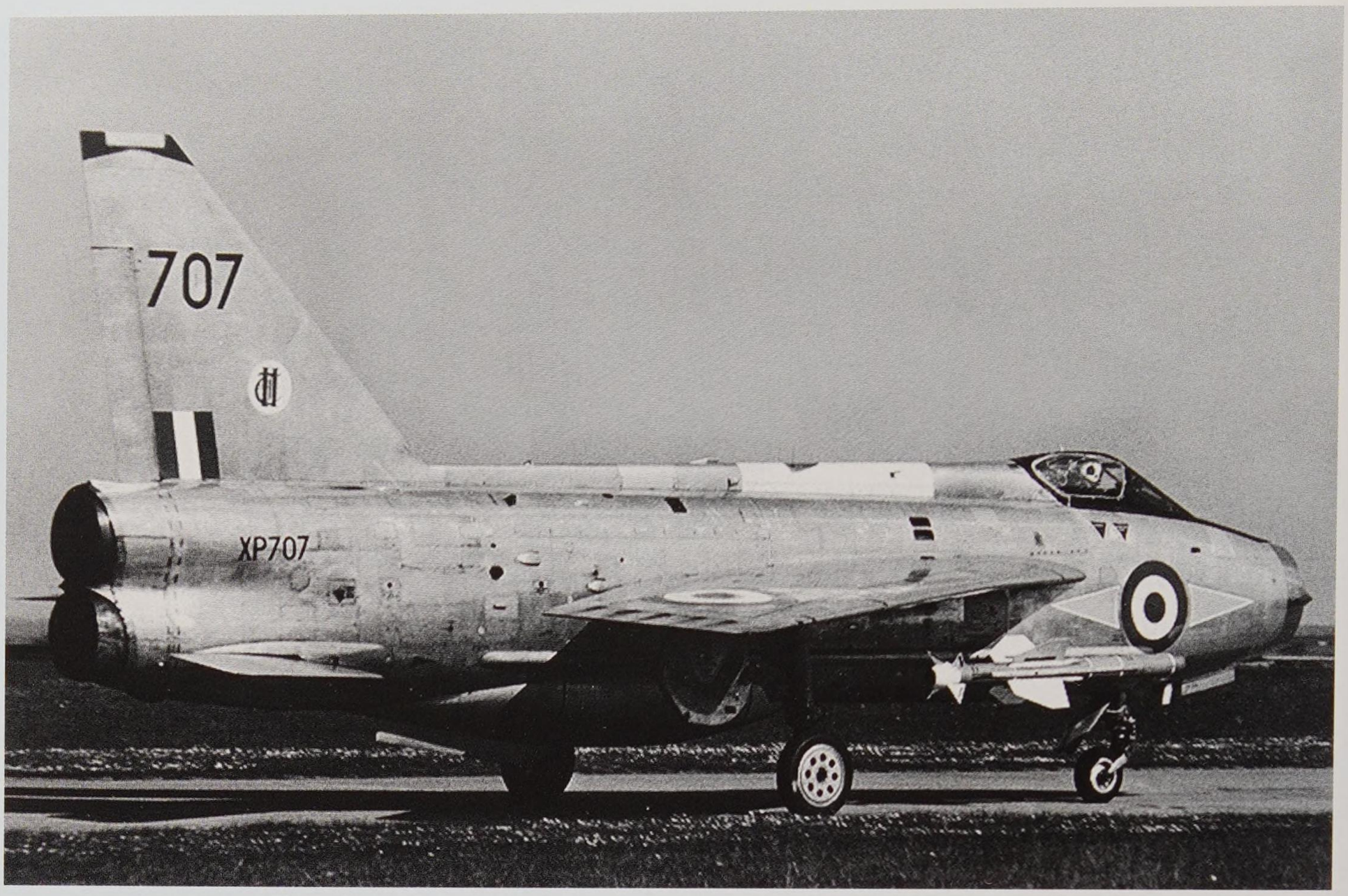
Interesting scene at Leuchars during 1970 with four Lightnings from No.23 Squadron about to get airborne, and a Lightning from No.11 Squadron in the background, adjacent to the unique Shorts SC9 Canberra which was being used by de Havilland on Lightning-related missile development work at this time. Also visible is the nose of another Lightning inside the QRA shed.
(Photo: Ian Hartley)

Atmospheric image of Gutersloh during the early 1970s with one Lightning F.2A thundering towards the runway for touchdown while another Lightning is visible getting airborne in the distance. The Lightning's extended flaps and airbrakes are prominently visible.
(Photo: Paul Tomlin)

23 Squadron Lightnings on the line at Luqa during October 1970. In the foreground, XR752 was being used as a Command reserve aircraft at Leuchars, shared between the two resident squadrons.
(Photo: Ian Hartley)

XP707 pictured during a visit to Binbrook whilst serving with the OCU at Coltishall in 1974. The aircraft was destined to be destroyed at Binbrook in March 1987 when it entered a spin during an aerobatic practice. A slow-feeding ventral fuel tank allowed the aircraft's centre of gravity to exceed the aircraft's limits and having lost control, pilot Barry Lennon ejected successfully, landing by parachute on the airfield. (Photo: Terry Senior)

XS928 illustrates the second of two grey colour schemes which were applied to the aircraft. Inexplicably, a surprising amount of effort seems to have been devoted to Lightning camouflage schemes during the last years of RAF service, resulting in a wide variety of finishes and hardly any two aircraft looking the same as each other – confusing and possibly pointless but great fun for plane spotters!
(Photo: Terry Senior)



Chapter Seven

LIGHTNING TWILIGHT

In formation for aerial photography for the last time, T.5 XS452 and F.6 XR728 over the North Sea on 13 April 1988. This photograph emphasises the widened upper forward fuselage of the T.5 as compared to the F.6, and the fatter fuselage spine behind the twin-seat cockpit. (Photo: Tim McLelland)

THE Lightning's history is littered with countless examples of how potential was consistently ignored by politically-driven cost cutting and an Air Staff which continually shifted its requirements.

Fundamentally, the Lightning was hampered by the persistent belief that it represented little more than an interim solution to Britain's air defence needs, until something – presumably in the shape of an all-capable 'super missile' – came along to replace it. The missiles, of course, never materialised. But by the time the service chiefs and politicians had accepted this, attention was drifting away from the Lightning towards new manned aircraft solutions. Consequently, the Lightning was always something of a 'Cinderella' and failed to attract the amount of development and improvement which could (and should) have been done had the will existed.

The continual belief that the Lightning merely represented a short-term fix was also the main reason it failed to attract significant success in the export market. There is no doubt that substantial overseas interest existed – what country could fail to have been impressed by a Mach 2.0 interceptor? But thanks to what seems an almost traditional British flair for snatching defeat from the jaws of victory, potential export sales were often ignored. Either that or they were actively discouraged because of foreign policy issues or in the foolish belief that other projects would somehow be more appropriate for prospective customers.

Of course, the British Aircraft Corporation (BAC) was all too aware of the Lightning's sales potential. The company made every effort to meet the interests of each prospective customer as they emerged. And interest in the aircraft came from a variety of countries including Australia, Germany, Singapore, Japan, Austria and even Nicaragua and Brazil. But when France and the United States were actively seeking export sales for their own designs (particularly the F-104 Starfighter and Mirage) the Lightning faced some stiff competition. Both countries' manufacturers enjoyed the full support of their governments and received substantial assistance in securing

Kuwaiti AF Lightning T55K 55-410 pictured at Warton prior to embarking on a test flight. The aircraft was delivered to Kuwait in December 1968. (Photo: Paul Tomlin)

export sales. BAC not only had to fight its corner virtually alone, but it sometimes also had to compete with conflicting information from British government officials who were busy advocating the advantages of other British designs which had not even left the drawing board – and never did.

This continual lack of wholehearted support for the Lightning even in its country of origin did nothing to convince potential export customers that purchasing the aircraft would be the wisest of decisions. Most importantly, had the Air Ministry shown more interest in a multi-role version of the Lightning, it is likely that BAC would have been able to develop the aircraft as a potent sales package much more quickly. Without any such support the company faced an uphill task in competing with France's cheaper and relatively simple single-engine Mirage and the full weight of America's attempts to sell the Starfighter. It was in fact the efforts of British businessman Geoffrey Edwards which finally secured the Lightning's first export success. Edwards had forged good contacts within the new 1964 Labour government and persuaded key individuals to support a possible sale of arms to Saudi Arabia. This was despite the reluctance of the Foreign Office to become involved in the business of supplying arms to potentially sensitive regions. Such was his influence that he quickly succeeded in arranging for three No.19 Squadron Lightning F.2s, supported by Valiant tankers, to be flown from Cyprus to Saudi Arabia where they could be demonstrated to their potential customer.

Stopping *en route* at Bahrain, the Lightnings had their RAF markings removed before reaching their destination. There, test pilot Jimmy Dell flew a number of demonstrations in XN730, culminating in what was the first supersonic flight over Saudi territory. His audience was certainly impressed and defence minister Prince Sultan requested that Dell fly a supersonic run over Riyadh. Dell managed to spare the city's inhabitants from a sonic bang but, having inspected the airport-city boulevard for overhead cables, he made a high-subsonic ultra-low run over the city. The flight resulted in near-hysteria from residents and the local media but Dell's showmanship succeeded in securing the interest of the Saudis. A few weeks later Royal Saudi Air Force test pilot Hamdan arrived at Warton to fly the Lightning F.2 for himself. Hamdan's previous fast jet experience was confined to the F-86 Sabre but, with a Lightning F.3 acting as chase `plane, he took an F.2 to Mach 1.2 (exceeding RAF limitations) and became the first Lightning pilot (and probably the only one) to exceed Mach 2.0 on his first solo.

Hamdan's recommendations undoubtedly assisted in the final decision to purchase the Lightning. An announcement was made on 21 December 1965 that a major arms deal was to be signed between Saudi Arabia and Britain. As part of this deal, BAC (English Electric) would manufacture 34 multi-role F.Mk.53 single-seaters and six T.Mk.55 two-seat Lightnings. The export model F.53 was based on the existing F.Mk.6 airframe, which was being manufactured for the RAF, although much of the design had its origins in a separate study for a multi-role project which the Air Ministry had rejected. It took advantage of the F.6's CLE wing and large ventral tank but featured additional mountings for weapons (rockets or bombs) under the wing, and the facility to add guns to the forward portion of the overwing tanks. Additionally, the forward part of the ventral tank was redesigned to carry two guns – an option which the Air Ministry had foolishly failed to adopt for RAF F.6s.

By comparison, the T.Mk.55 was essentially a straightforward twin-seat derivative of the single-seater, retaining the same CLE wing and large ventral tank. It was a logical development of the trainer variant and one which the RAF should have adopted but never did. Prototypes for both variants appeared quickly. Existing F.3 and T.5 airframes (XR722 and XS460) were simply taken from the production lines and converted, making their first flights on 1 November 1966 and 3 November 1967 respectively. But as production of the Saudi aircraft started, a more urgent requirement for the immediate supply of aircraft emerged. Incursions into Saudi airspace from North Yemen, together with similar interference from Egypt, prompted Saudi Arabia to hasten the delivery of arms. An additional order was placed for six Hunters, together with four single-seat and two twin-seat Lightnings, all of

which would be taken from existing stocks, refurbished and flown out to Saudi Arabia as rapidly as possible.

The four Lightnings, designated as F.Mk.52s, were actually F.Mk.2 aircraft which had been manufactured and placed in storage pending delivery to the RAF. The two-seat T.Mk.54s were T.4s taken directly from the RAF, one from 56 Squadron and the other from 111 Squadron. A further single-seater (XN729) was later supplied from the A&AEE test fleet as an attrition replacement for 52-657, which was destroyed after stalling during an over-rotated reheat take-off. XN734 was retained in non-flying condition at Warton to support the programme.

This first batch of aircraft was swiftly brought into service at Khamis Mushait with the RSAF as temporary substitutes for the main batch still being built. Although they had ostensibly been purchased as training and familiarisation aircraft, they were soon employed on operational duties. They were the first Lightnings to be engaged in combat, flying numerous missions against incursions from Yemeni ground units. Their presence was sufficient to deter any further interest by the Egyptians.

The new-build fleet of F.Mk.53 aircraft began to arrive on 1 July 1968 to equip No.6 Squadron RSAF at Khamis Mushait. These aircraft also went into action, employing their 2-in rocket launching and bomb-carrying capabilities in regular missions against Yemeni incursions. One aircraft was shot down by ground fire on 3 May 1970. The pilot ejected safely and the wreckage was recovered by a Hercules while other Lightnings flew top cover. The T.55 trainers were rather slower to arrive in Saudi Arabia. They had spent some time at RAF Coltishall where a separate training flight was established within 226 OCU to enable the Saudis to build up a core of experienced pilots and draw on RAF experience. For over a year, the four Saudi-marked Lightnings became a familiar sight around Norfolk before they finally left for the Middle East late in 1969, accompanied by the final pair of F.53s from the production line.

Unlike RAF Lightnings, Saudi Lightnings did see operational service, flying many operational missions during years of tension between the country and both Yemen and Egypt. (Photo: RSAF)

Lightning F.53K 53-418 participated in the 1969 Paris air show prior to being delivered to Kuwait, suitably equipped with an array of representative weapon loads. Of interest are the twin rocket launcher packs attached to (smaller) overwing fuel tanks – an ingenious fit which was never adopted for operational use on any Lightnings. (Photo: Paul Tomlin)

F.Mk.53, (Saudi Arabia) 53-679/206, 2 Squadron 1970

C/N 95284 ff T.M.S. Ferguson 4.3.68. Jeddah 16.9.68. Dhahran 7.4.70. 2 Sqn (206) 8.70, loaned to 6 Sqn 2.72, to 6 Sqn 4.72. 13 Sqn (1302), 2 Sqn (220 later S). 22.1.86 returned to Warton from Tabuk as ZF590. 2281.36 hours. To Portsmouth Marine Salvage.

The Saudis were greatly impressed by the Lightning's abilities. Although they found that maintaining the aircraft to be as big a headache as did the RAF, the RSAF's experience was undoubtedly positive. Commentators have suggested that the Saudi order had many political considerations attached to it, not least the notion that the US had refrained from competing against the Lightning to enable Britain to earn dollars to buy the F-111K. In reality the sale was made purely on merit, the Lightning being identified as the best aircraft available at the time.

Certainly the Saudis were reluctant to retire the fleet until absolutely necessary. When American F-5s were purchased to undertake many of the Lightning's ground support tasks, the Saudis transferred the Lightnings to air defence operations. To a lesser degree they were relegated to reconnaissance duties using purpose-built packs, although this role was also eventually dropped. It was the eventual purchase of more modern F-15 Eagles which finally prompted the retirement of the RSAF Lightnings and operations ended in December 1985. British Aerospace purchased the entire fleet to refurbish them for re-sale to new customers. They were ferried back to Warton in two waves in January 1986, the RSAF markings having been removed before collection by RAF pilots from Binbrook. Small British roundels and new serials were applied and the arrival of the aircraft at Warton caused a great deal of speculation that they might be transferred to the RAF. In fact, there was never any serious plan to do so as the F.Mk.53s and T.Mk.55s were substantially different from the existing RAF fleet. In any case, considering the relatively short time they would be in use the complication

The first four Saudi T.55s were delivered to Coltishall where they formed the basis of a separate Flight within 226 OCU, undertaking the training of Saudi pilots until the LCU was established in Saudi Arabia, at which stage the aircraft were ferried from the UK in company with two more T.55s from Warton. (Photo: Paul Tomlin)

A beautiful in-flight look at F.53 53-686 streaking skywards. This particular aircraft appeared at the 1968 SBAC Farnborough show registered as G-AWON. (Photo: Hedley Molland)

and cost of operating them would have been prohibitive even if the RAF pilots were delighted to have them. The T.55s with their larger ventral tanks and cambered wings would have been a welcome improvement over the RAF's straight-winged, small-tanked T.5 trainers. But the idea was never officially considered. It was all the more frustrating that RAF pilots from Binbrook were chosen to fly the Lightnings back to Britain.

British Aerospace, meanwhile, was quietly confident that Austria would purchase the Lightnings to replace its ageing Saab Drakens but the sale never materialised. Another less well-known plan to produce a batch of unmanned high speed target drones for the Ministry of Defence, intended as partial replacements for Meteors and Jindiviks, also came to nothing. The aircraft were inadequately protected from the rigours of the British climate and they rapidly deteriorated on the exposed airfield at Warton. Eventually they were offered for disposal and some went to museums around the UK. It was a sad end for a collection of very capable aircraft which had the potential to provide many more years of useful service.

Although Saudi Arabia's association with the Lightning was undoubtedly a happy one, Kuwait's experience was less fulfilling. As the second export customer, Kuwait signed a contract for 12 F.Mk.53Ks and two T.Mk.55Ks on 18 December 1966, the first being delivered in December 1968. Unusually, the aircraft entered service at Kuwait's international airport, where they shared airfield facilities and airspace with commercial traffic. This situation quickly proved to be unworkable as the airport became busier and Kuwait was obliged to develop two airfields at Ahmed al Jaber and Jakra to accommodate the new fighters.

The complexities of operating the Lightning came as something of a surprise and both airfields were ill-equipped to handle the technically-demanding aircraft. Serviceability soon deteriorated and, without any

Dramatic view of No.2 Squadron's F.53 53-682 captured on a sortie from Tabuk, passing the historic archaeological site at Mada'in Saleh. (Photo: Hedley Molland)

Impressive line-up of RSAF Lightnings at Dhahran, some of the aircraft carrying the badge of No.2 Squadron at the base of their tail fins. (Photo: British Aerospace)

operational combat requirement for the aircraft, flying became intermittent and eventually reached a stage where the aircraft were no longer regarded as economically viable. Kuwait decided to offer the aircraft for sale in 1973 after interest had been expressed by Egypt. But when the cost of bringing them back up to acceptable standards had been established, Egypt was no longer interested. Eventually, France offered Kuwait the much simpler and less-expensive Mirage F1 and the Kuwaitis disposed of their Lightnings in 1977.

The country's experience had been markedly different to that of Saudi Arabia, not because of any deficiencies in the aircraft but because Kuwait lacked the infrastructure to support such a demanding aircraft. Its limited experience of flying the Lightning, however, had been satisfactory despite the loss of three aircraft with another damaged beyond repair in a ground accident. British Aerospace surveyed the survivors with a view to buying

F.53s 686 and 696 from No.13 Squadron RSAF, pictured in flight near Dhahran, their home base. No.13 Squadron formed in 1978, undertaking the duties of the Lightning Conversion Unit, which had disbanded a year previously, in addition to other operational tasks. (Photo: Hedley Molland)

them back but their condition was so poor that the cost of refurbishing them would have been too high. Most aircraft ended their lives as static exhibits at various locations around the country. Some still survive despite the unwelcome attention of Iraqi forces when they invaded Kuwait in1990.

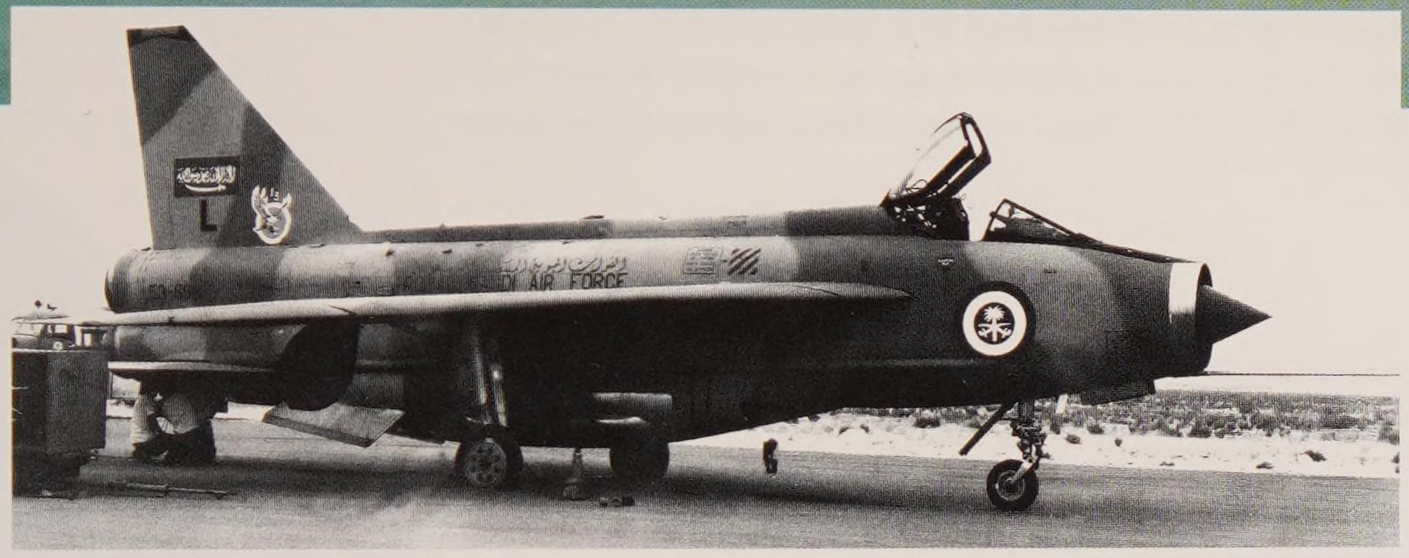
The sale of Lightnings to Saudi Arabia and Kuwait might well have prompted other Middle Eastern countries to buy the aircraft. Both Jordan and Lebanon showed some interest and even Iraq was identified as a potential customer. But with timing typical of the Lightning programme it was publicly announced that the aircraft was to be replaced in RAF service just as BAC was trying to sell it. Needless to say, this was enough to kill off any serious interest. Of course, the RAF had failed to add that the Lightning would not actually be replaced for some considerable time. Consequently, Saudi Arabia and Kuwait were the only countries to buy it and the opportunity to export the aircraft around the world was lost.

It was particularly unfortunate that official support was not forthcoming when English Electric tried to sell the Lightning to Germany. The aircraft would have been well suited to the country's needs and would almost certainly have encouraged other European nations to follow. Instead, American salesmanship persisted and it was the F-104G Starfighter which took the bulk of Europe's sales. This meant that NATO forces were equipped with an aircraft which was less than ideal for the environment and role in which it operated. Had the British government and export officials done more (or, indeed, anything) to sell the Lightning, NATO's order of battle might well have been very different.

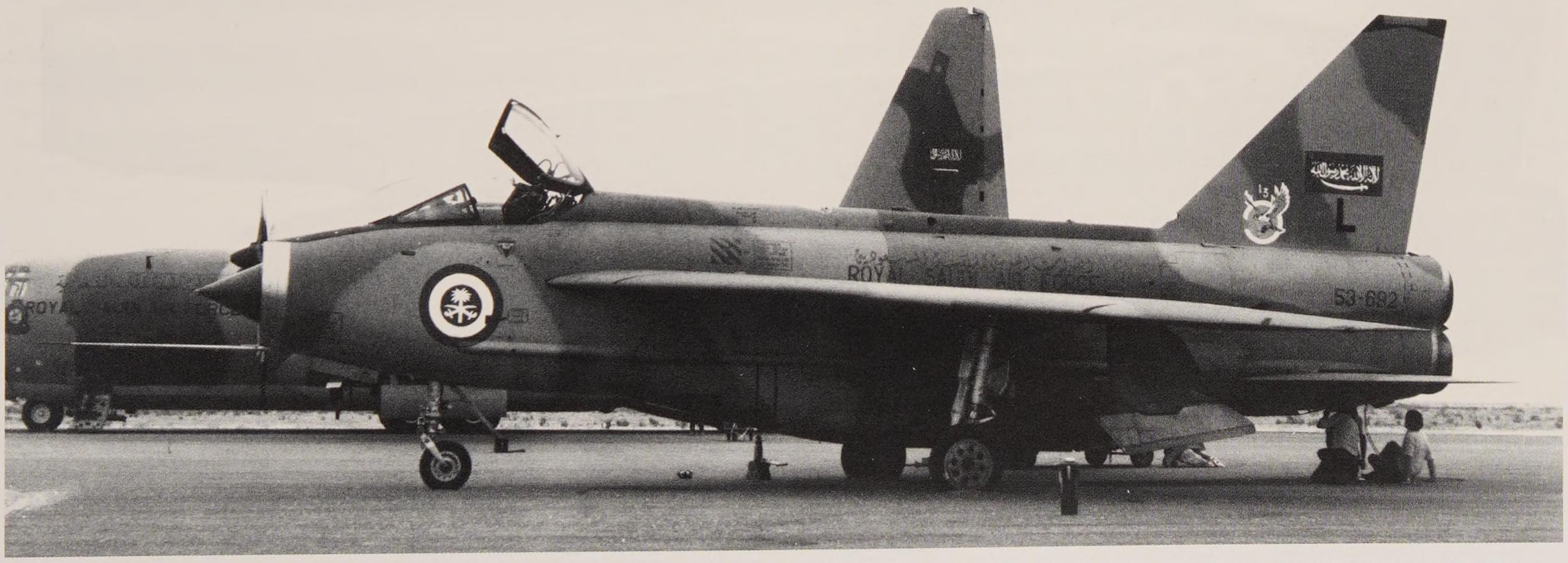
The sad tale of Lightning exports is matched only by the many examples of the way opportunities to develop its potential were continually overlooked. Almost from the very beginning of the P.1 programme, options to improve performance regularly emerged and were abandoned almost as quickly. The early (admittedly basic) head-up display was never adopted, nor was the revised wing leading edge, at least not until it was long overdue. It was a similar story with the enlarged ventral tank which could have been incorporated much sooner.

Even less explicable was the decision not to proceed with an ingenious auto-attack system which was successfully developed and tested. This enabled the pilot to lock-on to his target and vector the aircraft to it automatically. Test flights proved the system worked well. It was able to take the aircraft automatically to a precise intercept position with an accuracy and reliability in excess of even the most experienced fighter pilot's manual capability. As ever, the cost of the project (around £0.45m) was judged to be too high and it was dropped.

Other projects were dropped but with good reason. As early as 1954, English Electric proposed that a rocket motor boost the P.1's overall speed and altitude capability. The idea certainly had some merit when enemy bombers had the potential to enter UK airspace at speeds of around Mach 1.7 and altitudes over 50,000 ft. But there were significant disadvantages. The Napier Scorpion rocket engine, two of which would be fitted to the P.1, would each deliver 2,250 lb of additional thrust. They would be accommodated in the aircraft's ventral fuel tank, not only because no suitable space was



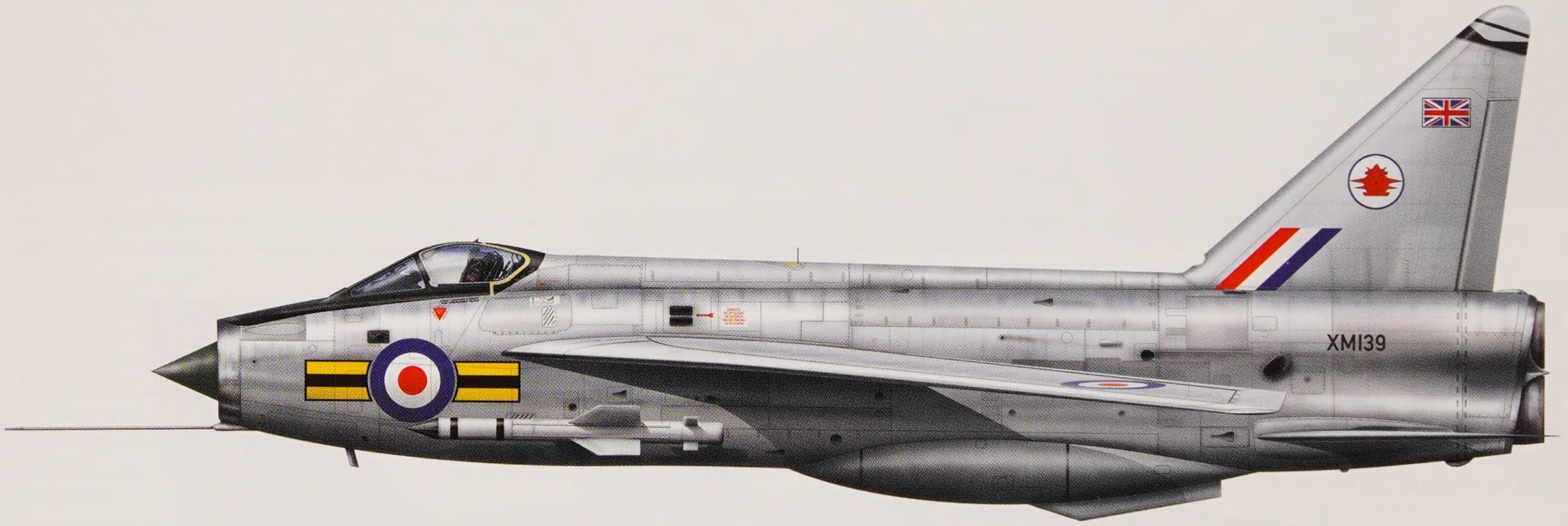
Above: A pair of Lightning F.53s from No.13 Squadron RSAF on a long gliding approach back to base. (Photo: Hedley Molland)



Although RSAF Lightnings were traditionally operated with an unpainted bare metal finish, two aircraft were painted in two-tone brown camouflage during 1977 as part of a short trial. 53-692/L (illustrated) was one of the aircraft, the other being 53-670/F (which also received light blue undersides). The camouflage was judged successful but the additional weight and drag of the paint degraded endurance and the concept wasn't adopted for fleet-wide use, both aircraft being returned to bare metal after a few months. 692 returned to the UK as ZF593, 670 as ZF578. Some retired Saudi Lightnings were painted in similar camouflage finishes when placed on static display. (Photo: RSAF via Hedley Molland)

LIGHTNING F.3, XR713, 111 Squadron 1971

C/N 95196 ff D. de Villiers 21.10.64. 111 Sqn (coded C) 8.1.65. To 60 MU then 111 Sqn (A) 25.11.71. To 5 Sqn (S) 15.10.74. To LTF (S) 16.3.76. To 11 Sqn (O) 5.9.78. ASSF and LTF loan various periods LAF markings applied. To 5 Sqn (AR) 29.4.82. LTF (later DD and DC) 20.8.85. To Leuchars for BDRT with 3160.50 hours. Allocated 8935M. On display 111 Sqn HAS complex.

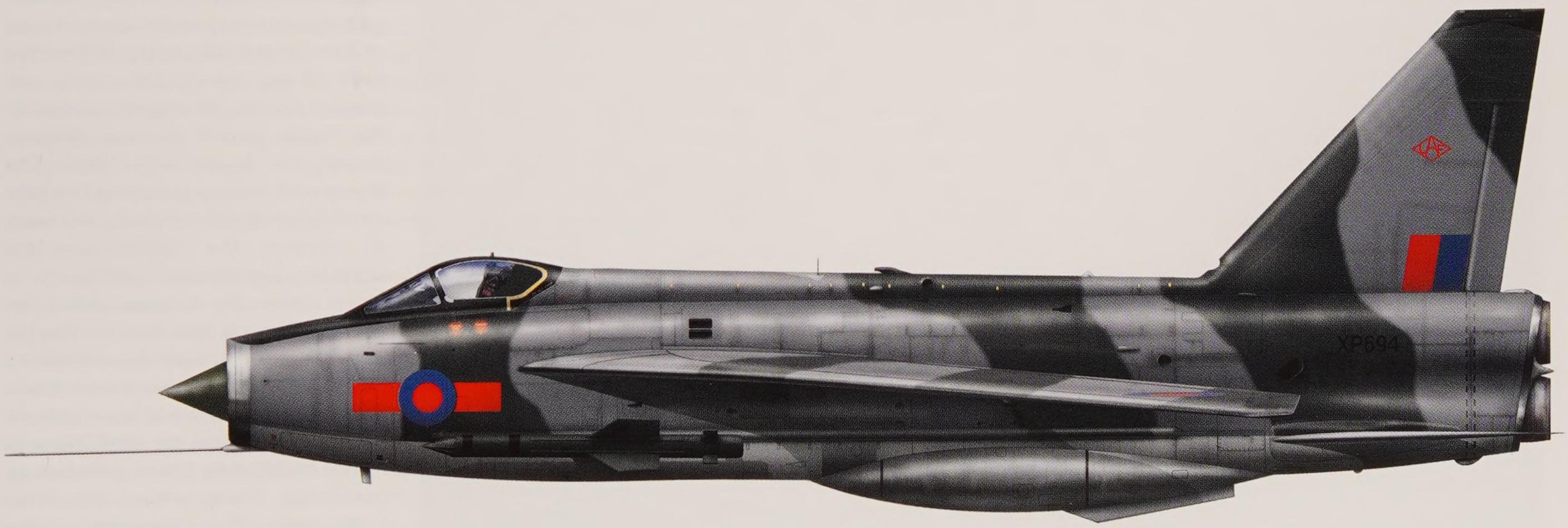


LIGHTNING F.1, XM139, Wattisham TFF 1970

C/N 95035 ff D. de Villiers 12.1.60. To 74 Sqn Coltishall (coded C) 2.8.60. To Warton for modifications then to 74 Sqn (F) 21.6.63. To 226 OCU (139) 21.4.64. To 33 MU Lyneham for storage and modification to target facilities standard. To Leuchars Tff 28.4.66. Cat 4 fuel pump problems necessitating wing change. To Wattisham Tff (A) 19.2.70. Solo display aircraft for 1970 SBAC show and 1971 Paris show. Last flight 4.74 with 1893 hours. Allocated 8411M to decoy duties at Wattisham. To Pendine by road 27.8.86. Sold as scrap to Birds Commercials, Long Marston 3.94.

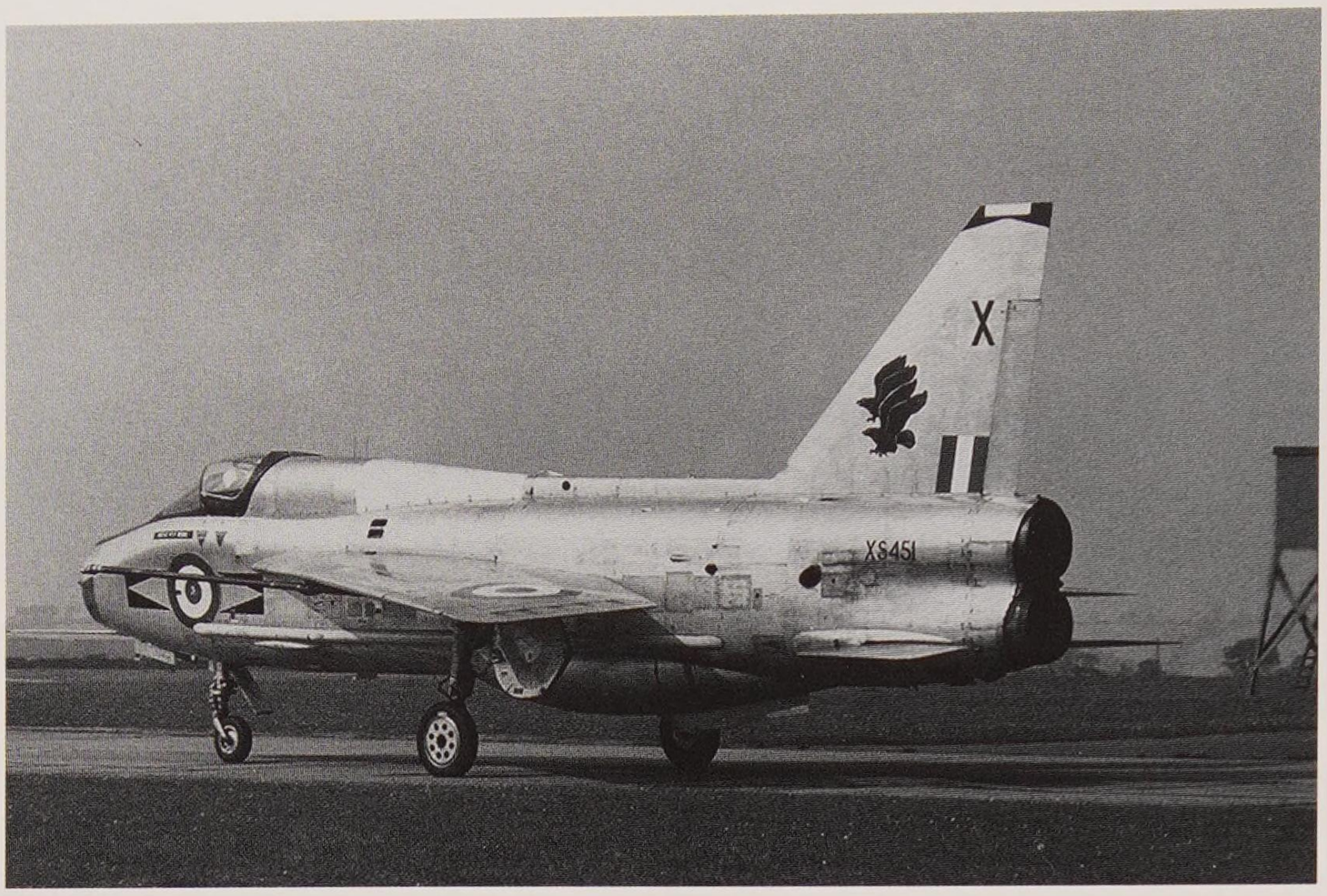
LIGHTNING F.1, XM145, Leuchars TFF 1966

C/N 95041 ff D. de Villiers 18.3.60. To 74 Sqn (coded Q) 14.5.62. To Warton for modifications then to 74 Sqn (H) 13.2.63. To 226 OCU (145) 3.6.64. To 33 MU Lyneham for storage and modifications to target facilities standard. To Leuchars Tff 26.4.66. To 60 MU Leconfield for storage 24.1.72, last flight with 876 hours. To Leconfield dump 6.74, sold as scrap to Shackletons, Siddal, 11.74.



LIGHTNING F.3, XP694, Lightning Augmentation Flight 1982

C/N 95117 ff R.P. Beamont 1.5.63. Retained at Warton on development work. To A Sqn A&AEE 1.8.63 for CA Release trials. On loan to MoA, operated by Ferranti on radar development. To 60 MU reconciled 26.1.67 for storage. To 29 Sqn (D) 18.5.67. On loan to 111 Sqn 8.9.70. Storage Flight Wattisham 1.1.75. To 56 Sqn (V) 3.3.75. To LTF 10.76 (coded A by 1.77). Repaint 22.2.78, last aircraft to receive grey/green camouflage. To 5 Sqn (coded R) 20.3.78. To 11 Sqn 7.5.82 initially with LAF markings, later coded (BO). Storage at Binbrook 1.6.84 with 2522.20 hours. Partially dismantled and transported to Otterburn 16.4.88. Scrapped 1999.



T.5, XS451, is pictured at Binbrook during 1975. A year later the aircraft was withdrawn from use, probably due to a series of problems with the auto-stabilisation system. However, after a period of some 24 years the aircraft eventually took to the air again in South Africa, with Thunder City – see below. (Photo: Terry Senior)

available elsewhere on the airframe but also because the rocket motors would need to be removed easily should the aircraft be required to fly in a standard, non-boosted configuration with a ventral tank full of fuel. This meant that the valuable fuel reserve normally held in the ventral tank would be lost and that even more fuel would be required from the aircraft to mix with a supply of extremely volatile HTP (high-test peroxide) to power the motors. English Electric looked at various schemes to provide additional fuel in the wings and flaps but the relatively simple rocket-boost concept began to take on complexities (and costs) out of all proportion to the perceived value, especially when Rolls Royce was promising much better performance from Avon developments. The engine was eventually test flown in a Canberra bomber but despite a detailed development and test programme the rocket motor pack was never fitted to any P.1s. There is, however, a commonly-held belief that it was due to a much-publicised English Electric promotional photograph showing a development batch (DB) Lightning in flight with rocket motors lit. Needless to say, the photograph was a clever fake. The Scorpion motor would certainly have given the Lightning an astonishing intercept capability but, in truth, performance with conventional jet power was more than adequate to counter the perceived threat.

Other design studies explored a variety of ways for developing the basic P.1 to handle various roles such as reconnaissance, low altitude interception and even strike and attack. Much effort was devoted to increasing the aircraft's fuel capacity and weapons capability. As the Red Top missile was being developed, the Air Staff examined the possibility of adopting other missiles, including the US Sidewinder. But it was believed at the time that it offered little advantage over the British-built and designed Red Top. Had service chiefs the foresight to anticipate the way the threat would eventually shift to low level and that a more versatile 'close-in' AAM would have been more appropriate, the Sidewinder could have been purchased from the outset. This did not happen even when it later became clear that the Firestreak and Red Top were less-than ideal weapons because of their firing parameters, combined with a growing concern that reliability was decreasing with age.

As it happened, the closest the Lightning ever came to receiving Sidewinders was during 1982 when an F.6 was temporarily adorned with a pair as a joke during missile practice camp at RAF Valley. The larger Sparrow missile was also investigated but the additional equipment needed to operate it would have required a substantial redesign of the aircraft and that option was never seriously considered. During the early stages of the Lightning's development, official thinking was firmly directed towards supersonic, high-flying bombers which therefore required an interceptor able to meet this threat. This almost led to what would have been the most significant improvement to the Lightning's capabilities had it been pursued.

As part of their considerations, the Air Staff considered equipping the Lightning with the American Genie missile, an extremely potent weapon which had already demonstrated its ability to cover more than six miles at speeds of around Mach 3.3. This would have brought even the fastest supersonic target flying over 60,000 ft well within the Lightning's reach. As if this capability would not be impressive enough, the Genie's warhead was nuclear. Its nominal yield of 1.5 kilotons effectively meant that even if an interception was not pressed home with extreme accuracy, the Genie would almost certainly destroy its target with ease. The Ministry of Supply looked at the idea and English Electric investigated ways of carrying the missile on the Lightning, eventually settling on a recess under the fuselage within an enlarged ventral tank fairing. The US was happy to supply the missile to Britain although the warhead's fissile material would have had to come from British stocks. The Air Staff were in favour of adopting the missile but, as usual, the Treasury was less than enthusiastic. The Chancellor of the Exchequer eventually said he would only agree to the Genie purchase in exchange for a reduction in the number of Lightnings ordered. Eventually the whole project was dropped and the opportunity to transform the Lightning into a truly formidable interceptor with devastating lethality was abandoned.

XS451, in the hands of Mike Beachyhead and his Thunder City operation. The markings may be slightly odd but the unmistakable proportions of the T.5 are a very welcome sight to countless visitors who visit South Africa to see (and hear) Lightnings in the air. (Photo: Ian Black)

F.Mk.6 XS903 was one of only a handful of aircraft which remained active until the very end of RAF Lightning operations without being repainted in grey camouflage. Pictured over the North Sea early in 1988, the aircraft was retired in June of that year and sold to Arnold Glass. After a period of external storage at Cranfield the aircraft was sadly broken up as scrap, the nose section being saved by a private buyer. (Photo: Tim McLelland)

Possibly the most bizarre of the many Lightning projects was one which met a Royal Navy requirement (AW406) for a multi-role fleet air defence, reconnaissance and strike aircraft. English Electric initially proposed a variant of the T.55 export aircraft. It showed great promise but the need for low carrier approach speeds was hardly something for which the Lightning was suited. English Electric addressed this issue by designing a completely new variable-geometry 'swing wing.' The outboard portions pivoted between 25 and 60 degrees, replicating the Lightning's usual wing layout for high speed flight but gave a much more acceptable approach speed. The lower launch speed would have been within the capabilities of existing carrier catapults.

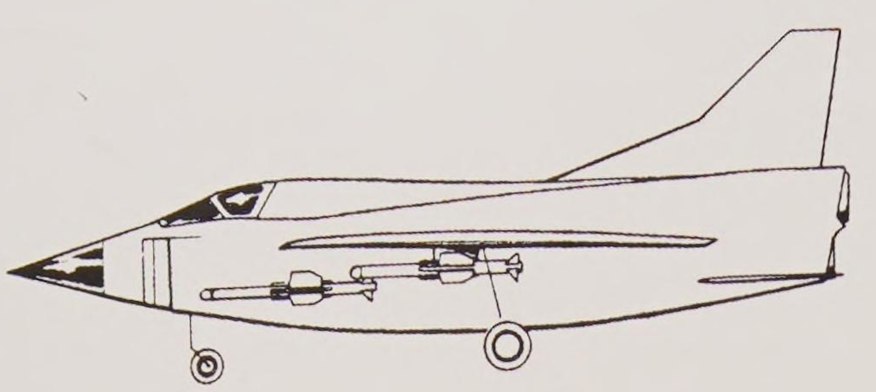
Freed from landing gear, which would now retract into a widened area ruled fuselage, the new wing provided an opportunity to increase fuel capacity. Eventually a completely new intake design was created which harked back to the cheek intakes explored early in the P.1 programme which would have enabled the required 30in radar to be accommodated. Significant interest was also shown in the new Rolls Royce Spey turbofan which looked like the most suitable power plant. It was this engine which eventually powered the Admiralty's ultimate choice, the Buccaneer.

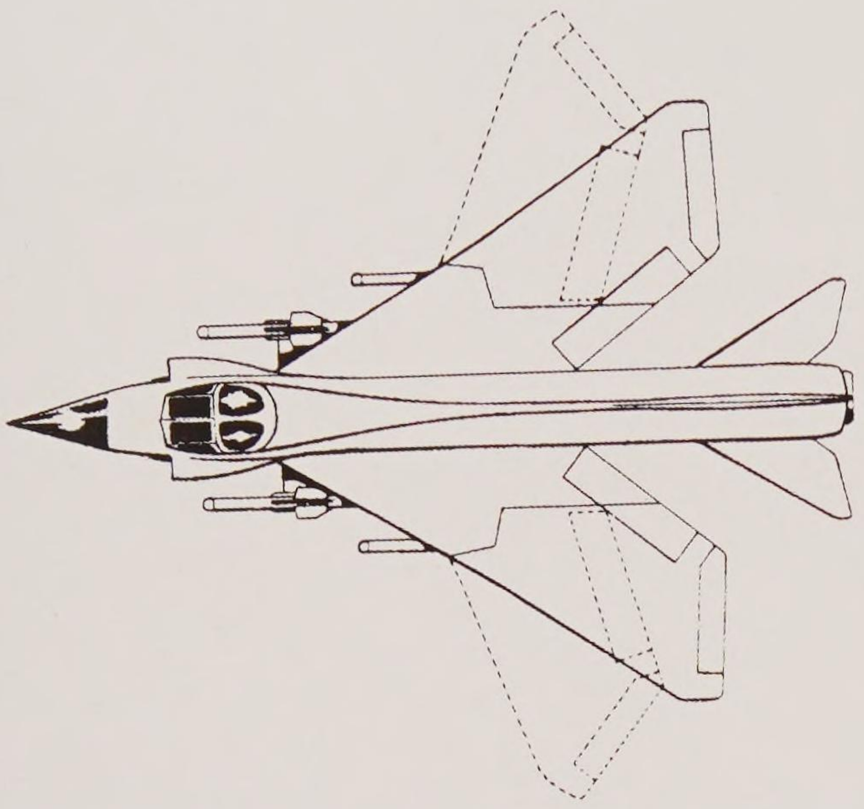
Ambitious though the naval Lightning was, Warton's later experience with swing-wing design suggests that, had an order been placed, a successful aircraft would have emerged. But, like the many other proposals, the swing-wing Lightning was destined to remain on the drawing board and the Lightning's development potential never progressed far beyond the F.Mk.6. It is interesting to note that shortly before the infamous 1957 Defence White paper emerged English Electric was actively working on yet another Lightning derivative. This featured a range of major improvements over the rather austere models being developed for the RAF. With a completely new wing providing capacity for fuel, the undercarriage retracting into an area ruled fuselage in the same way as the later naval variant, the P.8 also incorporated a two-man cockpit, RB.126 engines with fully convergent/divergent reheat nozzles and wing tip mounted missiles.

The P.8 was effectively created in response to the potential threat of supersonic bombers switching to low level attack, something which English Electric anticipated was likely to happen towards the end of the 1960s. Although the Air Staff did not necessarily disagree, their current thinking was still almost exclusively geared towards high-level attack. Combined with the prevailing belief in the emergence of all-powerful surface-to-air missiles, the P.8 never progressed beyond the preliminary design stage. Of course, the perceived threat did indeed switch to low level by the late `60s and Fighter Command's tactics had to change accordingly.

By 1970 it had been replaced by Strike Command and the change was accompanied by a gradual alteration in the Lightning's status within the RAF. Tactics had gradually moved to reflect the shift in Soviet capabilities and the Lightning was no longer regarded as a purely high-level interceptor. Operations were now more flexible, taking into account a whole variety of possible scenarios together with acceptance that the all-capable SAGW defences were never going to materialise. In effect, UK air defence was virtually the responsibility of the Lightning squadrons.

Perhaps the most noticeable shift in day-to-day operations was the re-introduction of the Aden 30mm cannon, which had been deleted from both the F.3 and F.6. It had become clear – especially now that the emphasis on high-level intercepts was slowly switching to low-level – that the Lightning's Firestreaks and Red Tops were far from ideal for the new environment. The trusty Aden cannon was sorely missed. With a cannon pack in the forward portion of the ventral fuel tank having been developed for the export F.53, the Air Staff accepted that it should be available to the Lightning squadrons. Although the F.3 fleet was not subject to modification, the cannon was purchased for the entire F.6 fleet, enabling these aircraft to switch between a mixed gun/fuel or all-fuel configuration as required. Like the RAF Germany





General arrangement drawing of what could have been the ultimate naval variant of the Lightning, combining variable sweep wings with RB153/61C engines, a new radar and cheek-mounted intakes. (Photo: British Aerospace)

Manufacturer's model of the proposed swing-wing variant of the T.Mk.5 which was offered to the Royal Navy. (Photo: British Aerospace)

Interesting factory photograph of XN725 displaying some of the ordnance which could have been fitted to the Lightning as part of a ground attack variant proposal which was proposed to the RAF but not adopted. Visible is a 1,000lb bomb, a Zuni rocket launcher and Bullpup missile. (Photo: British Aerospace)

F.2A squadrons, gunnery again became a major part of day-to-day training from 1970 onwards.

But having finally achieved what was at least an acceptable degree of flexibility, the end was finally in sight for some Lightning squadrons. Further defence cuts had led to a major reduction in the Fleet Air Arm's carrier force and, as a direct result, 25 Phantom FG.Mk.1s destined for the navy were redirected to the RAF. In September 1969 No.43 Squadron re-formed at Leuchars equipped with the new fighter. After a period during which the squadron operated alongside the two resident Lightning units, No.11 Squadron transferred to Binbrook in March 1972 and the gradual contraction of the Lightning force began. The first squadron to disband was No.74 based at Tengah. As part of the British withdrawal east of Suez, the unit disbanded on 25 August 1971, ferrying its aircraft back to Cyprus where they enabled No.56 Squadron to relinquish most (but not all) of its F.3 fleet.

The resulting availability of additional F.3s provided an opportunity for the last examples of the first-generation F.1A to be retired. Although most had long since disappeared, a number of ageing airframes were still active with the Operational Conversion Unit at Coltishall and with target facilities flights (TFFs) at Leuchars, Binbrook and Wattisham where they acted as high-speed interception targets for the Lightning squadrons. By 1974 the last of the F.1As had gone. With them went the TFFs, their role being absorbed into the remaining squadrons.

Meanwhile, the RAF had taken delivery of its own Phantom FGR.Mk.2s, although their entry into service was in the strike/ground attack and reconnaissance roles in which they replaced Hunters and Canberras. It was not until the Jaguar entered service that the Phantom fleet was reassigned to the air defence role. As more Jaguars arrived to replace them, the Phantoms were gradually released to replace Lightnings. This process started with No.111 Squadron which re-equipped with Phantoms at Coningsby before officially re-forming at Wattisham on 1 October 1974. The second Wattisham squadron (No.29) was also an all-F.3 unit, although 111 briefly operated a handful of F.6s shortly before disbandment. The lack of gun armament and shorter range made them the most appropriate candidates for early replacement by Phantoms. Foolishly, most of the F.3s were simply scrapped after retirement. Few people appreciated just how long the Lightning's gradual retirement would take, and in subsequent years their hasty destruction was regretted.

No.56 Squadron returned from Akrotiri in January 1975 and enjoyed a brief period back at Wattisham, operating a mix of F.6s and a handful of F.3s taken from the other units as they disbanded. No.56 finally said goodbye to the last Lightnings in June 1975 before re-forming as a Phantom unit at Wattisham on 7 July. This marked the end of Wattisham's long and happy association with the Lightning. In Scotland, No.23 Squadron was still operational on the Lightning but Leuchars was also about to bid farewell to the aircraft and No.23 Squadron disbanded on 31 October 1975. This left the entire UK Lightning fleet concentrated at Binbrook, where many of the former Wattisham and Leuchars aircraft were gathered for storage and refurbishing before being released for further use with the remaining two UK Lightning squadrons, 5 and 11. It appeared as if the mighty Lightning was about to disappear but, of course, its career was not quite over. Even though Fighter Command's former mainstay was now confined to just two operational squadrons at one base, the Lightning was still very much in business. As usual, though, the prevailing attitude was that the surviving Lightnings were once again acting as stopgaps and would remain in use only until the new Air Defence Variant of the Tornado entered RAF service. Few could have anticipated just how long this process would take.

When the final Jaguar deliveries had been completed the remaining 'freed-up' Phantoms were assigned to Gutersloh so that 19 and 92 Squadrons could also end Lightning operations in Germany. Perhaps more than anywhere else it was within RAF Germany that aircrews viewed their new fighters with mixed feelings. The Phantom was undoubtedly a very capable aircraft, having a two-man crew, good radar, good endurance and a very respectable arsenal of missiles.

On the other hand, Gutersloh's Lightnings were widely regarded as ideal aircraft for their role. With an adequate range, breathtaking speed and the option of two or even four Aden cannon on each aircraft, none of the pilots was eager to see them being withdrawn. In addition, the Phantom and its detachable gun pod, which never matched the Lightning's accuracy, seemed to be turning the clock back to the days of the Javelin and the two-man crew concept. It may have made good sense but did little to foster the fighter pilot spirit which prevailed among the Lightning crews. Being posted to Germany to fly the Lightning was the ultimate dream job for any aspiring RAF pilot and the new Phantom just did not have the same appeal.

No.19 Squadron disbanded on 31 December 1976 followed by 92 on 1 April 1977, being replaced by Phantom-equipped elements on 1 January 1977 and 1 April 1977 respectively. Although the arrival of a more modern and better-equipped fighter might have been cause for celebration, even the CAS commented, in a letter to the station commander: *'I can sense that the disappearance of the Lightning will be a sad day for you.'* Indeed, it was, but as the Lightning disappeared from Germany, operations at Binbrook were consolidated around a smaller fleet of aircraft, spread between two squadrons and many held in storage. No.11 Squadron's 'C' Flight eventually became a separate unit as the Lightning Training Flight. Each of the three units operated a mixed fleet of Lightnings. The two squadrons were mostly equipped with F.Mk.6s, although a small number of F.Mk.3s were also retained, together with a single example of the T.Mk.5 trainer for continuation flying. The LTF by comparison, comprised mainly T.5 and F.3 aircraft. One F.6 was assigned to the unit and often acted as a high-speed target aircraft equipped with a radar reflector Luneberg lens housed in a dummy Red Top round. Most F.6s were fitted with twin Aden cannon as standard. Some aircraft, particularly the LFT examples, occasionally flew without guns to take advantage of maximum fuel load.

The useful overwing tanks effectively disappeared for many years with overseas deployments greatly reduced. They were usually confined to occasional deployments to Akrotiri or Malta and most trips could be comfortably handled with tanker support, making the use of performance-reducing external tanks unnecessary. Fatigue considerations may also have played a part in the absence of the overwing tanks. Attention had to be paid to the amount of available airframe life remaining on each surviving airframe, especially when the proposed retirement date dictated by the availability of the Tornado F.2 began to slip. Damage to the skin of fins on various aircraft was one of the first signs that the Lightnings were beginning to show their age. This particular damage was eventually attributed to the jet wash produced by the Vulcan tankers which had been introduced in 1982.

But the airframes were undoubtedly getting old and a four-year wing root strengthening programme was initiated in 1979. This was applied to most remaining Lightning F.6 and T.5 airframes, the lighter F.3s being excluded from the modifications as they had been less badly affected and were closer to retirement. In 1985 British Aerospace conducted a 'Mod 9' modification programme on 35 F.6s which effectively gave them an additional 400 flying hr each. But despite the modifications, preserving the fatigue lives of the surviving aircraft became a priority and Binbrook's Lightning pilots were instructed to treat their aircraft gently – hardly the sort of thing an enthusiastic fighter pilot wants to hear. But even with manoeuvrability restrictions, Binbrook was still very much an elite club where the last of Fighter Command's magnificent machines survived, together with the last examples of an increasingly rare breed – the solo fighter pilot. Students completing advanced flying training on Hunters and Hawks had no hesitation in making their operational posting preference known – it was Lightnings every time.

For a brief spell in 1979 it looked as if the Lightning force might actually expand again. Tentative plans were made to reintroduce a third squadron, officially to be No.45, although many hoped that the rather more famous 74 Squadron might have been chosen. With the arrival of the Tornado F.2 still tantalisingly far-off, the opportunity to form an additional squadron using some of the nearly 80 Lightnings in storage at Binbrook seemed a sensible decision. Finding the pilots to fly them was harder and the idea was eventually dropped. By way of a cheaper solution, the Lightning Augmentation Force was formed. This was a reserve unit which would have been used operationally in wartime and manned by Lightning-qualified officers assigned to staff appointments.

Running six courses per year to train these 'ground tourists', the LAF had no specifically-assigned aircraft at its disposal but a variety of Lightnings were used as required. They were either pulled from storage or borrowed from the LTF and displayed the LAF's small logo on the tail fin. The scheme did not last for long. As the Lightning's retirement grew ever closer, the LAF disappeared. So too did the Lightning Training Flight, in April 1987, after the last five students had passed through. Ironically, all five were failed, but three later went on to fly the Phantom and Tornado – which says much about the demanding nature of Lightning flying. With the LTF gone the Lightning F.Mk.3 was effectively at the end of its useful life. Two aircraft were retained until the end of the year as air display mounts, the F.3, thanks to its lighter weight and

slightly better manoeuvrability, having been used for display flying since the demise of the F.1A.

The year 1987 was memorable for other reasons. The opportunity arose to use up the remaining stocks of Firestreak and Red Top missiles which would otherwise be redundant when the remaining two squadrons disbanded. Lightning units traditionally visited RAF Valley for armament practice camp where they operated with live missiles against unmanned target drones over the nearby ranges. Most MPCs involved the release of only a handful of live weapons although, by contrast, No.5 Squadron launched 23 missiles during its last visit to Valley, while No.11 fired a further 17 in September. No.5 Squadron stood-down on 31 October and flew its last Lightning sortie on 10 December, transferring some aircraft to No.11.

A few weeks earlier, the Empire Test Pilots' School at Boscombe Down had also relinquished its Lightning T.5 in anticipation of the imminent withdrawal of spares and support for the aircraft. By January 1988, therefore, only No.11 Squadron remained operational on Lightnings. With the Tornado F.2 now finally in service and often visiting Binbrook, the final months of Lightning operations could be conducted without restriction as there was no longer any need to maintain fatigue lives. With an almost limitless stock of supplies drawn from retired airframes, together with a surplus of missiles and an 'end of term' attitude, the RAF's surviving Lightning pilots enjoyed an unforgettable few months of flying. Now they could wring out every last drop of performance from their aircraft without worrying about g-limits or over-exuberant manoeuvring.

The party ended on 30 April 1988 when No.11 Squadron transferred its identity to Coningsby to convert onto the Tornado F.3. Binbrook then began to wind down and the remaining Lightnings were gradually flown out to new owners or to other RAF stations where they ended their days as crash and rescue airframes. The final pair of Lightnings departed from Binbrook on 30 June 1988. This was the day when the RAF's association with the Lightning officially ended, but even then the Lightning's career was not quite over.

The Tornado F.2's service entry had been a protracted and embarrassing business. Its technically-brilliant Foxhunter radar had shown great promise but it steadfastly refused to function to a satisfactory standard. It was this problem which delayed the aircraft's operational debut and many early aircraft spent much flying time with concrete ballast replacing malfunctioning radar sets. British Aerospace continued to work hard on ironing-out the difficulties and development work was still continuing as the Lightning reached the end of its service life. Among the last tasks performed by No.11 Squadron were regular sorties in support of the test programme. Four aircraft (XR724, XR773, XS904 and XS928) were refitted with overwing tanks to dramatically increase their range, albeit at the expense of speed.

Suitably equipped, the aircraft acted as high-speed target aircraft flying in the Aberporth range while British Aerospace flew Tornados and Foxhunter-equipped Buccaneers against them. The Lightnings were ideal target aircraft. They were able to provide a suitably high-speed target and one which, especially with overwing tanks, gave a radar return remarkably similar to what might be expected from a marauding *Backfire*. Ironically, the Lightnings were also valued for their endurance: with overwing tanks they could comfortably out-fly a clean Tornado F.2. Such was the success of the Lightnings' involvement in the trials programme that the aircraft were transferred from RAF to BAe control in March 1988 in anticipation of what was expected to be a two-year trials programme.

In fact, the Foxhunter's difficulties dragged on and the Lightnings continued flying in support of the programme until December 1992. During this extended period, XR724 literally ran out of flying hours and was replaced by XR773, which had been in storage at Boscombe Down. XP693 and XR773 finally left Warton on 23 December, bound for Exeter. There they were transferred to the care of the Lightning Flying Club which was hoping to maintain them in flying condition for operation on the civil register. XS928 remained at Warton to become a static exhibit and XS904 made its final flight from Warton on 21 January 1993, arriving at Bruntingthorpe for preservation. It was the last Lightning to fly in military markings. At long last the RAF's Mach 2.0 fighter had gone, nearly 40 years after the P.1A had first taken to the skies. Not bad for an interim design!

T.5 XS420 pictured at the moment of touchdown at Binbrook. The aircraft now resides with the FAST Museum at Farnborough, repainted in a silver finish. (Photo: Terry Senior)

Such was the Lightning's charisma that attempts were made to keep at least a few aircraft flying once RAF operations had ended. But the practicalities of flying such a complex and expensive aircraft proved to be too great for some. Increasingly restrictive safety stipulations laid down by Britain's Civil Aviation Authority made the task even more difficult compared to the more relaxed attitude in countries like the USA where a variety of relatively complex jet aircraft fly as civilian-owned warbirds. The Lightning Flying Club remained hopeful that at least one of their aircraft would be restored to flying condition. But the sheer cost of meeting the CAA's seemingly endless list of rules and regulations eventually proved to be too much for the team and the project was scrubbed. Likewise, an equally ambitious plan to fly at least two aircraft was announced by businessman Arnold Glass. He purchased six of the best Lightnings from the RAF and they were flown directly from Binbrook to Cranfield where they were placed in temporary storage. These plans were not to progress very far and the aircraft remained firmly grounded at Cranfield, slowly deteriorating in open storage.

Eventually, South African businessman Mike Beachyhead succeeded where British efforts failed. He purchased XS452 from Tony Hulls, who had previously rescued the aircraft from the Glass collection to restore it to 'taxiable' condition. Beachyhead arranged for the aircraft to be flown to South Africa to join a Buccaneer, Canberra and Hunters which he was already maintaining in flying condition. Despite a survey from

Pictured at Binbrook towards the end of Lightning operations, XS928 was flown in support of the Tornado Foxhunter radar programme and became one of the last Lightnings to fly in the UK, joining Warton's small fleet of radar target aircraft. Following the completion of the development programme, the aircraft was dumped but subsequently rescued, and is now on permanent display at Warton as a welcome reminder of the factory's long association with the type. (Photo: Terry Senior)

Lightning F.2A XN781 was retired to Leuchars on 5 April 1977, joining F.1A XM178 (retired January 1974) as part of the station's fleet of surface decoys. (Photo: Terry Senior)

South African authorities declaring XS452 fit to be flown out of the UK, the CAA refused to give authorisation for it to be flown from Cranfield. Eventually the aircraft was dismantled and transported to South Africa by sea, eventually being joined by Warton's trials aircraft, XP693, together with XS451 and XR773 from the Lightning Flying Club. Thanks to the rather less restrictive attitude of the South African authorities, the Lightnings were successfully restored and returned to flying condition in Cape Town. They now form part of the well-known Thunder City organisation.

As a result, people with a few thousand pounds to spare could treat themselves to the trip of a lifetime, in the right-hand seat of a Lightning T.5 in the skies over Cape Town. Those with less money can enjoy the occasional air show appearances which the Lightnings make in South Africa. Sometimes they are accompanied by a sonic boom but they are always guaranteed to impress. The only sad aspect to this success story is that despite an unblemished safety record with Thunder City, the attitude of the CAA remains, if anything, unforgiving and the chances of ever seeing a Lightning back in the skies of its country of origin are probably zero. It seems that the best that British Lightning aficionados can hope for is the occasional opportunity to see one move under its own power, even if leaving the ground is no longer permissible.

At Cranfield, Tony Hulls obtained a second Lightning from the Glass collection after selling XS452 to Mike Beachyhead. T.5 XS458 was carefully restored to running condition and the aircraft is now maintained as a working exhibit at Cranfield. There it makes regular and noisy engine runs with occasional trips to the active runway to perform high-speed runs among the assorted Cessnas on the airfield. In Leicestershire, two more Lightnings have survived to become working examples. They not only make regular high-speed runs along Bruntingthorpe's 10,000 ft runway, but

Lightning graveyard. For many years Binbrook's disused runway and surrounding area was the home to a variety of abandoned Lightnings which were initially retained as surface decoys but subsequently dismantled or scrapped on site. The scrap site was eventually cleared away and a few years later the same area became internationally famous as the filming location for many of the scenes in Putnam's movie 'Memphis Belle'. (Photo: Terry Senior)

A sad end to F.3 XP695 as the aircraft sits forlornly at Binbrook, prior to being dismantled and moved to the Otterburn range. (Photo: Terry Senior)

A substantial number of retired Lightning airframes were used as decoys at various airfields such as Wattisham, Gutersloh, Bruggen, Leuchars, Coningsby and (as illustrated) Binbrook. They were sometimes used for battle damage repair training, as illustrated by the repair patch on the rear fuselage of this aircraft which had already suffered the indignity of having her undercarriage collapse during a 'disaster' exercise. Most of the decoys were resprayed in representative green or grey/green camouflage and – not surprisingly – the airframes were eventually sold off as scrap.
(Photo: Terry Senior)

A fascinating but rather sad sight at Binbrook: a line-up for retired Lightning T.5s awaiting their final use as BDRT and decoy airframes. With the exception of the aircraft on the left, they are all former OCU machines, as indicated by the 'last three' digits on their tail fins.
(Photo: Paul Tomlin)

The Lightnings of Thunder City, Cape Town, South Africa

Dramatic in-flight shot of F.3 XP693 during a flight over Cape Town. Famous as the former 'Warton Lightning' assigned to a wide variety of test and development duties, XP693 was converted to F.6 standard and was retained by EE/BAC as a trials aircraft, eventually being retired in 1992 when the Tornado Foxhunter radar programme ended. The aircraft is still very much in business however, flying as ZU-BEY with Thunder City in South Africa. (Photo: Ian Black)

Thunder City Lightning trio in formation near Cape Town. If you have enough money, Thunder City would be more than happy to provide you with a supersonic ride in one of their Lightning T.5s. The ultimate birthday present perhaps?

XP759 ended her days (like many other Lightnings) on Wattisham's dump although parts of the airframe were transported to Binbrook's dump after this photograph was taken. A sad end for an aircraft which was once proudly displayed at Le Bourget. (Photo: Terry Senior)

also share accommodation in an authentic 'Q-shed' rescued from RAF Wattisham.

Andy Bonsell from the Lightning Preservation Group explains: 'After being forced to store both aircraft outside since their deliveries – XR728 on 24 June 1988 and XS904 on 23 January 1993 – we were alerted to the fact that the QRA shed at Wattisham was due for demolition. In fact, the tender had already been won, but we persuaded the demolition company, Trafalgar House, not to cut it up but take it down. They kindly did so with our help in December and January 1994/95. We then supplied seven low-loader trailers and transported the entire shed up to Leicestershire and unloaded it all at Bruntingthorpe.

'We then became the proud owners of hundreds of tons of rusty steel. After a lot of behind the scenes work to kick the project off, both in planning and starting a fund, we finally began the rebuild in May 2004 with a small kitty. We cleared the site, kindly given to us by David Walton, then moved all the steel on site and began the endless, thankless, task of sorting it all out, wire brushing and painting it all. The Second World War-era base on the site was then cut into and the uprights set on concrete plinths. The rest of the framework went up during 2005 and 2006. The floor level was then brought up to the correct height by tons of crushed bricks and levelled with the entrance driveway being widened and a few trees being removed.

'The concrete floor and apron were our next task, in October 2006. These represented the biggest outlay in cash terms. When it was completed we were then able for the first time to move both aircraft on to their own Q-shed pan. The roof was fitted by contractors Ikeston Roofing and we'd previously spent hours wire brushing and painting the frame again. But by Nov 2007 the aircraft had a roof for the first time. During 2008 we held our open days and kept the fund-raising going. This has enabled us to complete the preliminary work on the front doors in December 2008. We've worked hard rebuilding it ourselves wherever we can and we keep fund-raising to maintain the kitty. We have another two years of work before completion, both on the shed and fund-raising, with sides, back cladding and the back doors to do next. Total cost to date [2009] has been £125,000, with an estimated £30,000 to go.'

When the project is finally completed, visitors to Bruntingthorpe will be able to see a pair of Lightning F.6s emerge from Wattisham's Q-shed, roll on to the runway and roar away to the horizon, reheats blazing, before making a rather quieter return along the runway, brake `chutes trailing.

Meanwhile, across the Atlantic an even more exciting project was progressing in 2009. Lightning T.5 XS422 retired in 1987 after many years of service with the Empire Test Pilots' School at Boscombe Down and was being prepared for a return to flight. Max Waldron from the Anglo American Lightning Association describes the ambitious project:

'In mid-1986 XS422 was withdrawn from flying duties and officially struck-off charge on 28 October 1987. Nothing much was heard of XS422 until Andrew Brodie learned that a Lightning collection was for sale and talked his friend Jon Roth into becoming involved with a project. Jon ran the Vintage Aircraft Restoration Company at Stennis International Airport. Andrew then attempted to purchase a suitable airframe. However, armed with loads of enthusiasm and not much technical expertise in an aircraft of such complexity, Andrew needed a Lightning expert to ensure he got the best airframe. He was told about Phil Wallis, a stalwart in the Lightning preservation movement. Phil has 27 years of experience on the aircraft in RAF service and in various preservation projects.

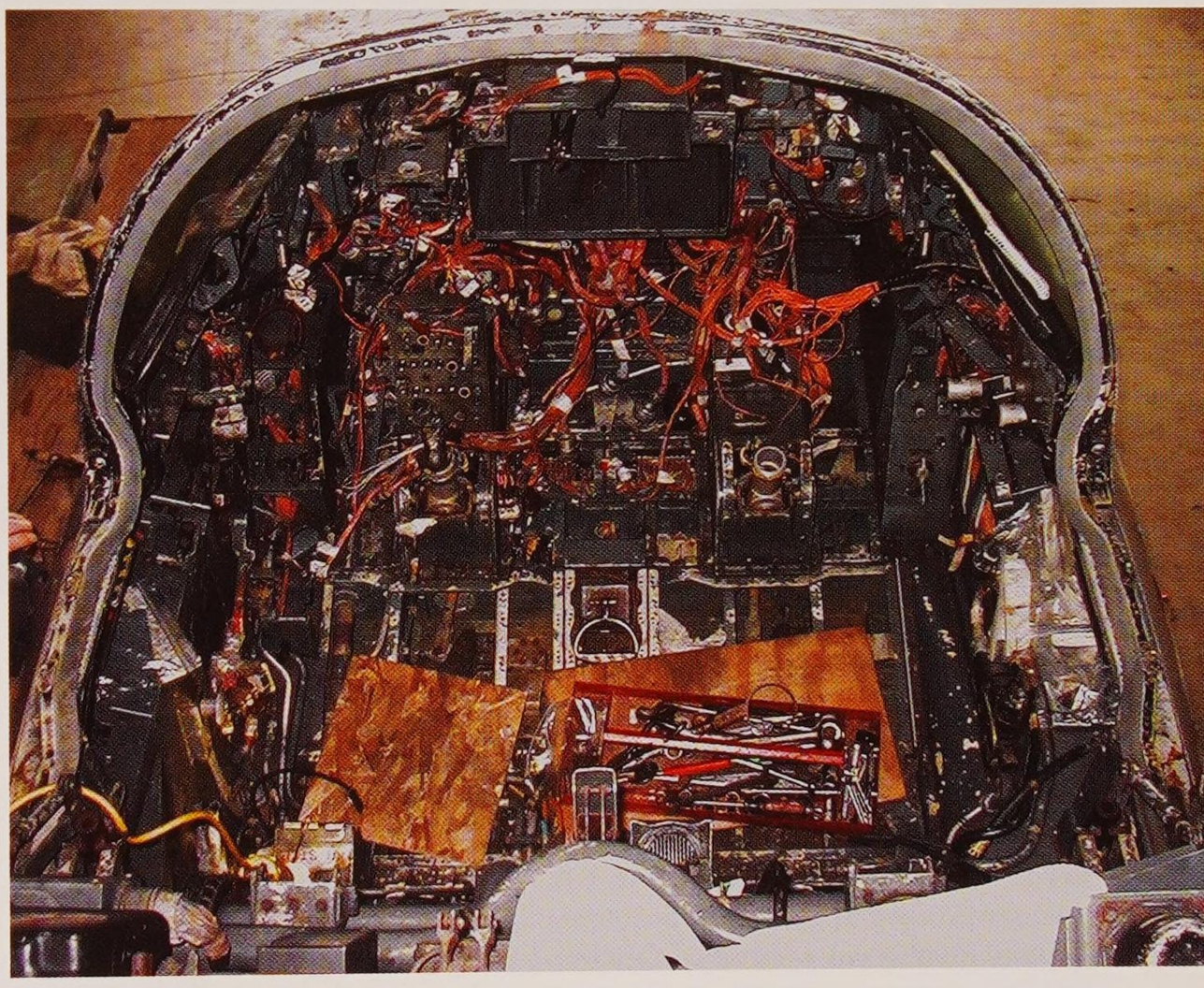
'Phil went down to Portsmouth with Andrew to view the 17 airframes and selected two: XS422 as the primary airframe and former Royal Saudi Air Force ZF597 (55-711) as a secondary one to act as spares source for `422. Once selected, a deal was finalised to purchase the two airframes plus engines and they were then readied for shipment. The Anglo American Lightning Organisation was born. Shipping the two airframes was just the start of this mammoth undertaking. It was soon realised that a substantial spares back-up was required to keep the project resourced with the amount of equipment and spares to restore XS422 and sustain her in operation. The team scoured the UK for ground equipment and suitable spares. Keith Smith of Marine Salvage sold the team the former RAF 20,000-piece war reserve of Lightning spares and a number of near zero-timed RR Avon 302R turbojets, capable of giving the jet 16,360 lb of thrust with reheat. He also provided a number of low-time reheat pipes, starter units, plus the forward and rear fuselage of ZF595, plus two sets of wings.

'The RAF paperwork system is being used to record the restoration and maintenance. This will ensure the highest standards are adhered to and the system satisfies the FAA inspector's scrutiny. The first trip the British contingent made was to extract the airframes from their containers. Due to the time the airframes spent stored in shipping containers, it was decided to carry out a 'penalty' major servicing on the XS422 airframe. Known as a 'check 4,' this is the most in-depth service and would ensure the airframe was inspected from top to toe and highlight any defects before assembly. XS422 will be flown in the USA as an Experimental Aircraft. In this category she can be displayed at air shows and fly freely over non-populated areas, in our case the Gulf of Mexico.

'It was decided that the inspection phase of the 'check 4' would be carried out before the start of any restoration. This is for a number of reasons, first to check and treat any corrosion and secondly to identify missing or unserviceable components. In February 2000 the final major inspections were carried out and work began on sealing the wing centre sections. It had

An interesting snapshot of XS422's dismantled nose section, packed amongst a load of support equipment ready for shipment to the USA prior to the commencement of a long restoration programme. (Photo: AALO)

Below left and below: As this picture illustrates, restoring a Lightning to flying condition is no easy task! The T.5's cockpit has been gutted and new/overhauled equipment is gradually being refitted, so that XS422 will be almost 'as new' when fully restored. The infamously cramped Lightning cockpit is much more spacious without the presence of the cumbersome Martin Baker ejection seat! The unusual throttle box arrangement can be seen, (below) with both sets attached to the port and starboard cockpit walls. (Photo: AALO)



XS422 emerges into the sunlight, minus tail, and engines, during her long rebuild at Stennis Airport. (Photo: AALO)

An in-progress picture of XS422's restoration at Stennis Airport. Back on her undercarriage, the open engine hatch reveals the absence of any power plants. Note the 'Experimental' titling applied on the nose, indicative of the terms of the aircraft's FAA registration. (Photo: AALO)

been decided that this would be our only chance of getting the wings and fuel tanks sealed. All the old and dried sealant was removed from the outside of the wings and the tank sealing plates removed so as to gain access to the inside of the wing. Once in, the whole area was cleaned to the highest standards. One of the main problems was a lack of qualified ex-Lightning people. Ideally, we wanted ex-Lightning personnel or people with good fast jet knowledge. Another major headache was the electrical looms as hundreds of wires had been cut to get the aircraft apart. The identification tags on these cables were either missing or had perished.

'At Stennis the team members set about their tasks. We started on the wiring and completing the tank and wing sealing. This job relied heavily on the preparation being correct and many hours were spent on this area. Other jobs carried out were identifying many bolts and pipework. Once identified, photocopies of the relevant Air Publication (AP) were highlighted and boxed up with the items. It was decided that the aircraft assisted escape system (AAES) be made live and operable. Fortunately, Sgt Glen Turner, a Royal New Zealand Air Force armaments technician, offered AALO his help, having been involved with ejection seat-equipped warbirds in New Zealand for many years. Phase one of the restoration was complete: XS422 had been fully inspected and prepared for reassembly. The aircraft was in superb condition and, although it had been in storage for several years and not flown for 14, there had been very little degradation of the airframe and its systems.

'Jon Roth and Andrew Brodie had been working hard to seal a deal that would hopefully see two Lightnings in the skies of the USA. AALO's original intention had been to restore XS422 to flight and once that was achieved work would begin on T.55 ZF597. It would have taken approximately eight years before ZF597 was in the air again. Negotiations with Brian Reynolds of the Olympic Flight Museum resulted in his purchasing ZF597 from AALO. Brian has a huge reputation for restoring warbirds to exacting standards and he will do a fantastic job on ZF597. We will enjoy the benefits of having another operator to work alongside. So it's a win-win situation for both Brian and AALO. The combined assets of ZF595 and `596 have now become the spare aircraft and major sub-assemblies and will be despatched as required.

'Airframe reassembly started on 2 July and within less then two weeks the wings were mated, with copious amounts of sealant being used. The tricky task of joining the rear fuselage to the wings then began. Constant adjustment of both the wing and fuselage angles and elevations were necessary as slowly it inched into position. The job was accomplished on 17 July with minimal problems. Once this was done, the undercarriage was lowered and on 20 July 2001 XS422 stood on her wheels again. It was a major milestone for the project and one the team felt very proud to have reached.

'Remaining items to be re-installed included the ailerons, flaps, fin and tailplanes. The ailerons were completely overhauled, given a coat of fresh paint and re-installed. The flaps were given the same treatment and were re-installed at the same time. The tailplanes were readied and painted. On Sunday 16 September XS422 was rolled out of the hangar for the first time to let all inspect her at close quarters. It was the first time `422 had been outside as a whole aircraft for over ten years. During January the FAA granted AALO the registration number for XS422. She became N422XS.

'To start getting more components over to the USA, another container of equipment was shipped. It was decided the engines to power `422 would go and they were duly packed with great care and sent on their way. The container arrived at Stennis in April 2002 and the American team

members had a huge smile on their faces as they got their hands on them. With the goal of flight looming ever closer the team on both sides of the Atlantic ramped up activities.

'The previous 24 months had been an exceedingly busy time for the AALO. Although the organisation was always short of finance, as many projects like this are, we managed to maintain nearly all our goals. While in the UK, the team has been involved in various activities. The reheat pipes were being worked up to flight status at a location in Lincolnshire. The spares sorting was practically completed and work was progressing towards another shipment of vital spares to fuel the project in 2004.

'After Hurricane Katrina caused such devastation along the Mississippi Gulf coast during August 2005 it was a miracle that XS422 escaped totally unscathed. The water from the tidal surge and the flooding of the River Jourdan were literally only metres away from the project hangar and the spares storage. Katrina was a true monster of a storm and the most destructive and costly in modern American history. After the immediate storm it was very difficult to get an exact picture and it was only after a few days of frantic texting and `phone calls did it all become clear. Every US volunteer on the project suffered some form of loss and, indeed, two members of the organisation decided to move north and rebuild their lives away from the Gulf of Mexico.

'To this end the return to flight restoration of XS422 was put on hold as she was safe and secure and in no danger. People were the primary concentration of our efforts and thoughts. During the next few months, AALO members got together to restart the project. Obviously, there was some trepidation in that we didn't know what we'd find at Stennis, but we discovered that some normality had returned to the coast. The main engineering plan was to get the engine bays ready for engine installation, the cockpit repairs made and installed and then the controls steadily refitted. During the 17 days the team worked on XS422 during that trip many goals were achieved and it was hard for Phil Wallis to actually stop the team working so as to get a shower and food in the evenings. The team put in between 10 and 11 hours per day and, what with the 30 min drive to and from Stennis to Gulfport, they were extremely long days. However, it was all worth the effort.

'Both engine bays were effectively finished with some very minor items requiring attention. The cockpit refurbishment was a tremendous effort. It was great to see the control surfaces being moved from the cockpit, something that hadn't happened in over 20 years. The leading edge tanks steadily progressed and by the end of the first week the starboard tank was fully fitted and plumbed in. The port tank soon followed and by the middle of week two this was also fitted. It was great to see another goal achieved. Also receiving attention were the final elements of the starter system, refurbishment of the ventral tank hook assembly and the missing bolts of the fin assembly were fitted.

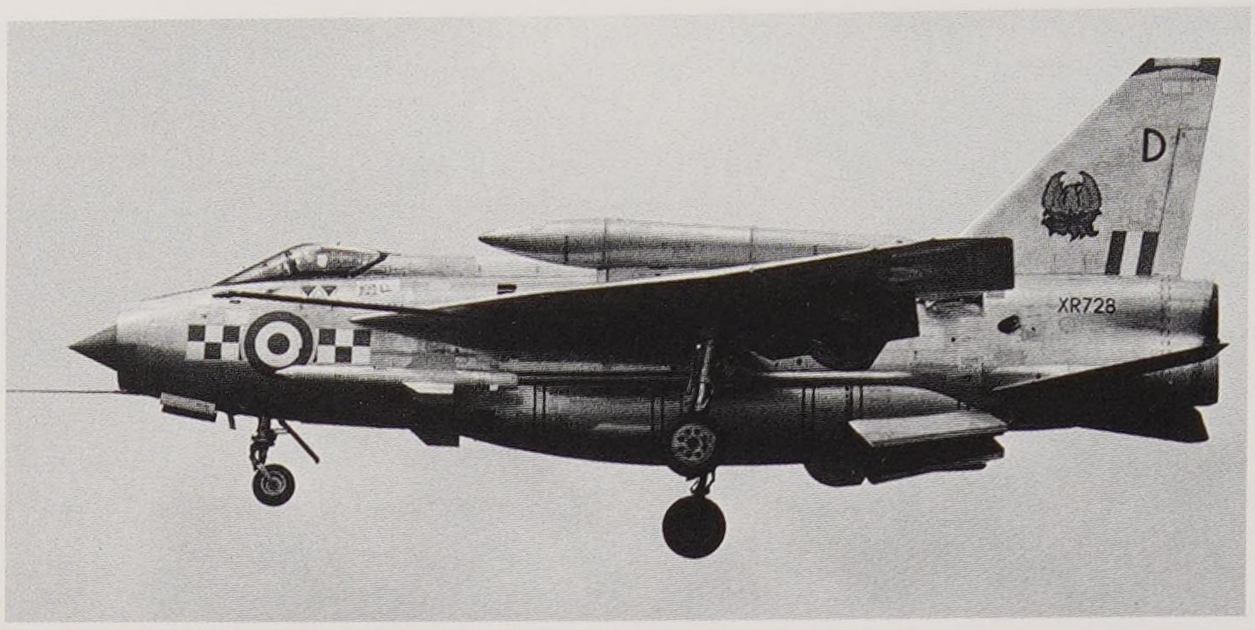
'Finally, the aircraft was prepped for hydraulics and all the controls and undercarriage were given a comprehensive operation. During February 2006 we sent electricians over to advance the electrical system rebuild. The team covered a two-week period and, again, significant progress was made with the port side of the aircraft completed and also the cockpit floor. This left the aircraft ready for further mechanical components to be refitted in the cockpit area.

'During November 2006 a team of ten engineers set off from the UK and covered almost a month of intense activity. The final inspections required in the engine bays were carried out and the final wires of the loom assemblies finally connected. New cable covers had been manufactured and were test fitted and readied for final fitting. A great deal of work was carried out in the cockpit and the pitot static system was tested and repaired. Hydraulic systems were operated and a final consolidation of tasks completed so as to be ready for the aircraft to be able to accept fuel.

'The UK engineers made numerous trips during 2007, cumulating in a three-week spell of activity in November. During the early months of 2007, fuel was added to the tanks for the first time in over 20 years. Despite all the previous preparation, a number of leaks were discovered and these have been diagnosed and all repaired. Some were cured by cleaning and re-sealing and others were found to be non-return valves that had become unseated due to the various moves and disassembly before `422 was saved in 1996. In 2008 XS422 was fully fuelled again and the system fully checked, the tanks brought to full working pressure and any leaks found and cured.

'The cockpit rebuild has been a huge undertaking as it's been a ground-up rebuild. Progress in this area has been nothing short of a miracle. Again, 2008 included a number of visits which involved fuel testing and the final leak checks to the start of refitting the cockpit. With the right finance in 2009 XS422 will be very close to getting her engines fitted again. We are always looking for donations and support to keep the project alive and anyone who would like to actively support the project can contact us through our web site.

Although firmly grounded, F.6 XS904 still makes quite an impression with both 'burners blazing, thundering along Bruntingthorpe's 10,000 ft of Lightning-friendly runway. (Photo: John Davidson)



Although preserved by the LPG at Bruntingthorpe in grey/green camouflage, this 1970s-era picture illustrates XS904 in bare metal finish, complete with full-sized unit markings. Unusually, XS904 remained with No.11 Squadron throughout her service life, and was only temporarily assigned to other units for brief periods. (Photo: Terry Senior)

XR728 complete with overwing tanks which (rather unusually) are unpainted. This aircraft is maintained in good condition at Bruntingthorpe by the Lightning Preservation Group and occasionally makes a spirited reheat run along the airfield's generously-proportioned runway. (Photo: Terry Senior)

'AALO has now formed a supporters' group and all profits will help push this project on at a realistic timescale. All group members who are visiting the USA and come to the restoration facility will be given full access to see this fascinating restoration project at close quarters. Since the team's last visit, AALO hasn't let the grass grow under its feet. The next trips have already been planned and financed and will include team member Glen Turner travelling from New Zealand to start the process of getting the escape system hot and ready for flight.

'Glen already has the primary and secondary seats at his workshop in New Zealand and so another milestone is on the horizon [in 2009]. We are often asked when XS422 will fly and the short answer is: when finance allows. XS422 is owned by the whole engineering team. Members are rewarded with shares in the project. All contribute with cash and time and while we are always looking for a substantial backer we are – and will – make steady progress. Rome wasn't built in a day. XS422 has been a complete ground-up rebuild, probably the most comprehensive ever undertaken on a type such as this.'

Exciting though this project is, there is a certain sense of sadness that the project has to be undertaken so far away from the country where the Lightning was designed, manufactured and operated. But the dedication and persistence of groups such as the AALO will ensure that somewhere the unmistakable sight and sound of English Electric's masterpiece can still be experienced.

It is indeed ironic that an aircraft which was expected to have a spectacularly short flying career has become one of the most enduring icons of British military aviation. And deservedly so. Quite simply, the Lightning was the ultimate creation of Britain's aviation industry. Nothing else ever came close.

Typical scene at Bruntingthorpe early in 2009 as the LPG continue work on the reassembly of Wattisham's Q-shed, and one of their two Lightnings receives some attention from the Group's engineers. (Photo: Tim McLelland)

RAF LIGHTNING UNITS

No.5 Squadron
Equipped with Javelin night fighters, 5 Squadron disbanded at Geilenkirchen in October 1965 and re-formed at Binbrook to begin Lightning operations. First aircraft assigned to the squadron was T.5 XS451/T which arrived on 19 November 1965 and the first two single-seaters arrived in December, these being Interim F.6 models and as such the squadron was the first to operate this variant (which became the F.6). When many Lightning squadrons transitioned on to the Phantom, 5 Squadron remained active at Binbrook and eventually became the longest operator of the type, disbanding on 31 December 1987 before re-forming on the Tornado F.3 at Coningsby. The squadron currently operates Sentinel aircraft from Waddington.

F.1A
XM169/X
XM181/Y
XM183/X

F.3
XM694/R
XP701/AN/AR
XP702/P
XP706/R/AR
XP707
XP741/X/AR
XP750/Q/AQ
XP753/X/Q/S
XP764/S/AR
XR713/S/AR
XR716/AS/Q
XR718/S/P/AS
XR749/Q
XR751/R

T.5
XS416/AT/AZ
XS419/T
XS451/T
XS455/T
XS457/AT
XS458/T/AT
XS459/AW
XV328/T

F.6
XR723/D/A
XR724/AG/AV/AE
XR725/J
XR726/N/K/AE
XR727/AB
XR728/JS
XR747/P/E/X/AL
XR752/B/H
XR753/B/F/AG/AL
XR754/G/AE
XR755/A/O/F
XR756/B/G/AG
XR757/C/AL
XR758/D/E/F/AF/AH
XR759/E/R/AH
XR760/F/G/B
XR761/J/AC
XR762/K
XR763/H/AL/AE/AN/AP
XR764/P
XR765/M/J/AJ
XR767/S
XR768/P
XR769/S/AM
XR770/B/AA/AJ
XR771/C/AK/AN
XR772/E/AD
XR773/A/AH/AF/AB
XS894/F
XS895/B/AL/AK
XS897/AL
XS898/K/J/AK
XS899/G/AA/AJ/AM/AF
XS900/M
XS901/D/AH
XS902/J
XS903/A/C/AM/AO
XS919/C/A/F/AD/AL
XS920/AL/AF
XS921/H/AB
XS922/H/AC/AG/AF
XS923/C/A/AA
XS942/E
XS925/D/AD/AP
XS926/B
XS927/G
XS928/L/F/AJ/AU/AH/AD
XS931/G/D
XS932/F/AM/AC/AG
XS933/G/AJ
XS935/B/J/AB/AK
XS936/AK/AL/AS/AB
XS938/E

No.11 Squadron
A former Javelin unit, 11 Squadron disbanded at Geilenkirchen at the end of 1965 and re-formed at Leuchars on 1 April 1967, equipping with Lightning F.6s. Following the departure of 74 Squadron to Singapore, No.11 Squadron was one of two operational Lightning squadrons at Leuchars, the other being No.23. When its air defence role was taken over by the Phantoms of No.43 Squadron in March 1972, the unit moved south to Binbrook and briefly assumed responsibility for training Lightning pilots when the OCU disbanded, until the Lightning Training Flight was formed in October 1975. No.11 Squadron remained active on the Lightning until the very end of the RAF's association with the type, and the unit flew the very last RAF Lightning sortie (a delivery flight to Cranfield) on 30 June 1988. The unit disbanded on 30 April 1988 and re-formed on Tornado F.3s at Leeming before re-equipping with Typhoons at Coningsby.

F.3
XP694/BO
XP695/O/M
XP701/O/BN
XP702/N/BN/BO
XP706/BM
XP707/BM
XP737/P/N
XP741/N/O/BO
XP748/P
XP749/BK1/BK2/BO
XP753/L/O
XP761/O
XP764/O
XR713/O
XR718/BK1
XR720/M/BN
XR749/BM/BO
XR751

T.5
XS416/T/Z
XS417/T/BT
XS451/X
XS452/Y/T/BT
XS454/Y
XS456/T
XS457/W
XS458/BT
XV328/BZ

F.6
XR723/L
XR724/M/K/BC
XR725/BA
XR726/BE/BM
XR727/F/G/BG/BM
XR728/BA/BF/BS
XR747/BF
XR752/D/BH/BL
XR753/A/BA/BP
XR754/E/A/BC
XR755/J/BJ/BF/BN
XR756/J/BB/BH
XR757/D/A/BE/BA/BL
XR758/J/BF
XR759/H/BJ
XR760/Z/BD/BL
XR761/F/BF
XR762/H
XR763/B/E/BE
XR765/C
XR769/J/B/BB/BG/BE
XR770/X/BN
XR771/BA/BM
XR772/C/BB
XR773/D/BD/BR
XS895/BC
XS897/H/BE/BC/BD
XS898/BM/BD
XS899/C/BC/BL
XS901/BJ/BH/BK
XS903/BC/BE/BA
XS904/A/D/BD/BM/BQ
XS918/B
XS919/C/BN/BB
XS920/E/B/BB
XS921/L/F/BA
XS922/L/BJ
XS923/J/BG/BE
XS925/J/BD
XS927/M/H/BH/BB
XS928/D/BJ
XS929/E/BF/BC/BG
XS930/F
XS931/G
XS932/H
XS933/J/BE
XS934/K
XS936/G
XS937/M/K

No.19 Squadron
Conversion from the Hunter on to Lightnings began in 1962 at Leconfield, the unit's first aircraft being T.4 XM988 which arrived during October of that year. After re-equipping, the squadron switched from Fighter Command to Second Tactical Air Force, RAF Germany and moved to Gutersloh, becoming operational there in 1976, standardising on the F.2A variant (although some non-modified F.2 variants were retained, mostly used as target facilities aircraft). Operations continued at Gutersloh until 31.12.76 when the unit disbanded, re-forming as a Phantom unit at Wildenrath. The squadron is now part of No.4 FTS at Valley, operating Hawks.

F.2
XN727/A
XN730/B
XN769
XN774/C
XN775/D
XN776/E
XN778/F
XN779/G/X
XN780/H
XN782/K
XN787/M
XN791/P
XN794/W

F.2A
XN724/F
XN726/D
XN731/Z
XN733/R/Y
XN735/A
XN771/P
XN776/C
XN777/K
XN778/H
XN781/B
XN783/G
XN784/G/R
XN786/M
XN789/J
XN790/L
XN973/H

T.4
XM970/T
XM973/V
XM991/T

No.23 Squadron
Equipped with Javelins, the squadron exchanged its aircraft for Lightnings in 1964, the first deliveries being XP707 and XP808 which arrived in August of that year, and by October the unit was fully re-equipped. Deliveries of the Interim F.6 began in May 1967 and by 1968 the unit had standardised on the F.6 variant, although T.5 dual control aircraft (one or two aircraft) were also assigned to the unit, together with various F.1A models used by the target Facilities Flight which operated as a stand-alone unit and as part of the squadron at various times. The squadron's QRA commitment was transferred to No.111 Squadron (with Phantoms) and the unit disbanded on 31 October 1975, re-forming as a Phantom squadron at Coningsby (moving to Wattisham). The squadron subsequently operated the Tornado F.3 from Leeming before being assigned to E-3 Sentries at Waddington.

F.1A
XM144/X
XM169/W
XM178/Y
XM182

F.3
XP705/K
XP706/R
XP707/A
XP708/B
XP735/E
XP736/F
XP737/L
XP750/P
XP751/K/Q
XP752/O
XP756/C
XP757/G
XP758/D
XP759/J
XP760/K
XP761/N
XP763/M

T.5
XS417/Z
XS419/T
XS421/T

F.6
XR723/F
XR725/A
XR727/F
XR728/D
XR747/K
XR752/U/G
XR753/V/A
XR754/M/D
XR756/M
XR757/R
XR758/E
XR760/H
XR761/P
XR762/L
XR763/G
XR765/A
XR766
XR767/S
XR770/L
XS895/N
XS899/E
XS927/O
XS935/J
XS936/B
XS937/C
XS938/E

An unusual photograph of 5 Squadron Lightnings on exercise at Luqa. Two aircraft are parked on the visiting aircraft pan while two more aircraft are lining up on runway 24 for take-off just a hundred yards or so away. Visible in the distance is the secondary runway which was later developed as the main runway for Malta's international airport. (Photo: MoD)

No.5 Squadron dabbled with a variety of unit marking applications during 1978 after the adoption of grey/green camouflage across the entire Lightning fleet. XS898 received an unusual red fin tip on which the squadron's maple leaf motif was superimposed in green. (Photo: via Ray Deacon)

XR756 pictured early in 1984 whilst assigned to No.11 Squadron but still carrying the nose markings of No.5 Squadron, the unit with which the aircraft had previously served. (Photo: Terry Senior)

No.11 Squadron applied black spines and tail fins to two F.6s, one being XR725/BA, and the other being XS903 as illustrated. After joining 11 Squadron in July 1987 the aircraft lost part of its rudder in flight and the black trim was applied during repairs at Binbrook. The aircraft is now on display at Elvington. (Photo: Terry Senior)

Magnificent photograph of five Lightning F.Mk.2As bearing the markings of No.19 Squadron, shortly after delivery to the unit at Leconfield. (Photo: MoD)

One of seven Lightnings painted in representative squadron markings in celebration of the Lightning's 25th anniversary in 1979, No.11 Squadron's XR761 received No.74 Squadron's colours. The aircraft crashed off the Donna Nook range in November 1984 following an engine fire. (Photo: Terry Senior)

Pictured at Leconfield in 1964, F.Mk.2 XN789 was returned to Warton just a year later to be modified to F.Mk.2A standard after which it became the first Lightning F.2A to join No.19 Squadron.(Photo Tim McLelland collection)

Three F.Mk.6s armed with Red Top missiles, on No.23 Squadron's flight line at Leuchars during the early 1970s. (Photo: Terry Senior)

XS419 pictured at Leuchars during 1974 whilst with No.23 Squadron. A year later the aircraft went to Warton as a chase aircraft for the MRCA (Tornado programme) prior to joining No.5 Squadron and the LTF at Binbrook. (Photo: Terry Senior)

A graphic illustration of the need to get the Lightning's undercarriage retracted before limiting speed is reached. The main gear is already tucking away as XP700 of 29 Squadron gets airborne from Wattisham. (Photo: Keith Wilson)

XP694 was initially assigned to test and development work prior to entering RAF service. In 1979 the aircraft (which was camouflaged by this time) received 29 Squadron markings as part of the Lightning's 25th anniversary celebrations. (Photo: Terry Senior)

A much-published picture which illustrates the magnificent colour scheme applied to No.56 Squadron's Lightning F.3s when first delivered in 1965. Sadly, the markings were just a little bit too flamboyant for higher authorities and by the following year, the Lightning squadrons were forced to adopt rather more conservative unit markings. (Photo: MoD)

1965 was undoubtedly the most colourful period in Fighter Command's post-war history. The Lightning squadrons were quick to take advantage of the Lightning's shiny metal finish and applied eye-catching unit markings to their aircraft although, as can be seen, No.19 Squadron retained standard unit markings and continued this practice until disbandment in 1977. It was the application of No.56 Squadron's dazzling red/white check design to their newly-delivered F.3s which finally ended this colourful period, prompting some rather stuffy RAF chiefs to call for a return to more sober markings. (Photo: MoD)

No.29 Squadron
Based at Akrotiri with Javelins, the squadron's air defence commitment was transferred to 56 Squadron (with Lightnings) in May 1967, and the unit returned to the UK, re-equipping with Lightnings at Wattisham. First delivery was T.5 XV328 on 10 May 1967 with the remainder of the unit's aircraft arriving by the end of the year (mostly from 23 and 74 Squadron). Declared operational in September 1967 the unit remained at Wattisham operating only the F.3 variant (plus the T.5 trainer) until disbandment on 31 December 1974 after which the unit re-formed at Coningsby on Phantoms. The unit currently operates Typhoons from Coningsby.

F.3
XP694/D
XP695/C
XP698/B
XP700/K
XP701/M/F
XP702/C
XP703/G
XP705/B/L
XP707/H
XP708/F/N
XP735/L/J
XP736/G
XP737/J
XP743/B
XP745/H
XP747/S
XP755/E
XP756/K
XP757/F/M
XP758/S
XP759/S
XP762/A
XP763/G
XP764/E/C
XP765/A
XR715/R
XR716/U
XR718/C
XR751/Q

T.5
XS422/O
XS452/X
XS459/T
XV328/Z

No.56 Squadron
First deliveries began in December 1960 with XM172. By March 1961 the unit was operational on the F.1A variant. In 1963 the squadron was selected to become the official Fighter Command display team (the 'Firebirds') and the squadron's aircraft were re-coded and painted for their display role. The first F.3 was delivered in February 1965, and the unit's F.1As were gradually transferred to the OCU at Coltishall. The squadron transferred to Akrotiri in April 1967 and deliveries of Lightning F.6s began in 1971 when 74 Squadron disbanded in Singapore. The unit operated a mixed fleet of F.3, F.6 and T.5 aircraft together with three Canberras used for target facilities. Returning to Wattisham in January 1975, 56 Squadron continued operating both F.6 and F.3 aircraft until disbandment on 28 June 1976 before re-forming on Phantoms at Coningsby.

F.1A
XM169
XM171/R/A
XM172/S/B
XM173/V/C
XM174/Y/D
XM175/T/E
XM176/D/F
XM177/N/G
XM178/O/H
XM179/F/J
XM180/H/K
XM181/X/L
XM182/P/M
XM183/K/N
XM190
XM213

T.4
XM989/X

F.3
XP694/V
XP695/N
XP698/T
XP699/O
XP700
XP701/W
XP702/R
XP703/S
XP743/G/K
XP744/H
XP745/J
XP756/K
XP747/L
XP748/M
XP753/J
XP755/U
XP759/T
XP764/V
XP765/N
XR716/U
XR717/B
XR718/C
XR719/D
XR720/E
XR721/F
XR748/P
XR749/Q
XR750/A

T.5
XS417/Z
XS422/Z
XS452/X
XS456/A
XS459/X

F.6
XR725/Y/P
XR728/D/J
XR759/P
XR761/A
XR764/E
XR770/D
XR771/C
XR773/N
XS897/S
XS901/T
XS919/R
XS921/Q
XS922/P
XS928/E
XS929/L
XS932/R
XS933/K
XS934/B

No. 74 Squadron
The first operational Lightning squadron, deliveries began with F.1 XM165 at Coltishall on 29 June 1960. During 1962 the squadron was selected as the official Fighter Command display team (the 'Tigers') although no specific codes or paint schemes were applied for the season. After moving to Leuchars in 1964, the unit re-equipped with the Lightning F.3 beginning in April of that year when XP700 was delivered. Deliveries of full production standard F.6 aircraft began in 1966 and in June 1967 the squadron transferred to Singapore. The unit remained at Tengah with Lightning F.6s (and a T.5) until disbandment on 25 August 1971 when its aircraft were transferred to Cyprus. Re-forming as an F-4J(UK) squadron at Wattisham, the unit reappeared as part of No.4 FTS at Valley, flying Hawks.

F.1
XM134/A
XM135/B
XM136/C
XM137/D
XM139/F
XM140/M
XM141/D
XM142/B
Xm143/A
XM144/G
XM145/H
XM146/L
XM147/J
XM163/K
XM164/L
XM165/F
XM166/G
XM167/H

T.4
XM974/T

F.3
XP698/F
XP700/A
XP702/C
XP703/G
XP704/H
XP705/K
XP706/L
XP751/B
XP752/D
XP753/J
XP754/M
XP755/P
XP764/H

T.5
XS416/T
XS454/T
XV329/T

F.6
XR725/A
XR758/J
XR759/G
XR761/B
XR764/E
XR767/E
XR768/A
XR769/B
XR770/C
XR771/D
XR772/E
XR773/F
XS893/G
XS895/H
XS896/J
XS897/K
XS920/L
XS921/M
XS927/N
XS928/L

No.92 Squadron
A former Hunter unit, No.92 Squadron began re-equipping with Lightnings at Leconfield during 1963 when the first aircraft (XN783) was delivered to the unit on 17 April. Operational just a few weeks later, the squadron displayed a formation team of Lightnings at the Farnborough show in the same year. During December 1965 the unit transferred to Gelsenkirchen (the base which was originally intended to become the centre of RAFG Lightning operations) but later moved to Gutersloh in February 1968, joining No.19 Squadron. The unit re-equipped with Lightning F.2As during 1969 although a small number of unmodified F.2s were retained until the early 1970s. After disbanding at Gutersloh on 31 March 1977, the squadron re-formed as a Phantom unit at Wildenrath, subsequently becoming a component squadron of No.4 FTS at Valley.

F.2
XN928/B
XN731/M
XN732/H
XN733/L
XN735/J
XN768/S
XN769/Z
XN783/A
XN784/L
XN786/D
XN788/R
XN790/E
XN792/N
XN793/K
XN794/P

F.2A
XN726/N
XN727/W
XN728/V
XN730/J
XN731/L
XN732/R
XN733
XN735/U
XN771/S
XN772/N
XN773/E
XN774/F
XN775/B
NC776/C
XN777/K
XN778/A
XN780/J
XN781/B
XN782/H
XN787/L
XN988/P
XN791/D
XN792/M
XN793/X

T.4
XM698/Q
XM995/T
XM997
XM971

No.111 Squadron
After forming at Wattisham, the unit's first Lightning (F.1A XM185) arrived in March 1961 and by the end of the year the squadron was operational. Deliveries of Lightning F.3s began towards the end of 1964 and the squadron continued to operate the F.3 variant (together with a single T.5) until disbandment on 30 September 1974, although by this stage a handful of Lightning F.6s had been assigned to the squadron. After re-forming as a Phantom unit at Coningsby (later moving to Leuchars), the squadron re-equipped with Tornado F.3s.

F.1
XM140/R
XM146/J

F.1A
XM169/B
XM181/M
XM184/A
XM185/C
XM186/B
XM187/D
XM188/F
XM189/E
XM190/G
XM191/H
XM192/K
XM213/L
XM214/N
XM215/C
XM216/P

F.3
XP700/Z
XP701
XP706/D/F

XP738/G/E
XP739/H
XP740/J/B
XP741/K/D
XP742/L/G
XP746/J
XP748/G
XP749/B/K
XP750/H
XP751/L
XP752/Y/D
XP753/Y
XP754/X/H/R
XP758/S
XP759/G/F
XP761/Z/N
XP762/M/C
XR711/A
XR712/B
XR713/C/A
XR714/D
XR715/E
XR716/F
XR719/Z
XR720/Y
XR748/M
XR750/N

T.5
XS421/T
XS422/T
XS450/T
XS452/T/X

F.6
XR747/X
XR752/Y
XS895/Z

Air Fighting Development Squadron
Central Fighter Establishment
The AFDS was formed on 1 September 1959 at Coltishall (the unit's former base at West Raynham having been judged unsuitable for Lightning operations). Tasked with the operational evaluation of the Lightning and its associated weapons systems in a tactical environment, the first Lightning F.1 (XG334) arrived in December 1959. After moving to Binbrook in 1962 the first F.2 variant was assigned to the unit and the first F.3 arrived in January 1964. The first Interim F.6 was delivered in November 1965. Trials continued until 1 February 1966 at which stage the AFDS became the Fighter Command Trials Unit.

DB Aircraft
XG334/A
XG335/B
XG336/C

F.1
XM135/D
XM136/E
XM137/F
XM138/G
XM163/H

F.2
XN726/KXN729/L
XN771/M
XN777/N

F.3
XP695/R
XP696/S
XP749/T
XP750

.4
XM973

Interim F.6
XR753/U
XR752/V

Fighter Command Trials Unit
The FCTU continued the work which had been undertaken by the AFDS, forming at Binbrook on 1 February 1966, remaining active until 20 June 1967 at which stage the unit disbanded and their aircraft were transferred to Binbrook's target facilities Flight.

F.1
XM137/Y
XM164/Z

F.3
XP695/R
XP696/S

F.6
XR752/V
XR753/U
XR766/W
XR767

Lightning Conversion Squadron
Formed on 29 June 1962 the LCU was the forerunner of the Lightning OCU, equipped with aircraft borrowed from 56, 74 and 111 Squadrons as required. Its first assigned aircraft was T.4 XM970 which arrived at Middleton St.George on 29 June 1962 and by the end of the year ten T.4s had been delivered, after which the unit was re-formed as No.226 OCU.

No. 226 Operational Conversion Unit
Formed as part of the CFE at Coltishall on 4 January 1960, the OCU was tasked with the training of Lightning pilots. After initially operating aircraft borrowed as required from 74 Squadron, the unit moved to Middleton St.George during August 1961 as the Lightning Conversion squadron, being re-designated as No.226 OCU on 1 June 1963. After receiving Lightning F.1s to supplement the fleet of T.4s already assigned to the unit, the OCU adopted the 'shadow' designation of No.145 Squadron until May 1971 when it was exchanged for No.65 Squadron. The OCU moved to Coltishall on 13 April 1964, receiving its first T.5 (XS419) on 20 April. By 1971 the CU had divided into three component units; No.1 (Conversion) Squadron operating T.4s and F.1As (65 Squadron), No.2 (Weapons) Squadron flying the T.4, T.5 and T.1A (65 Squadron), and No.3 (Advanced) Squadron flying F.3s and T.5s with their own '2T' Squadron markings. The OCU disbanded on 17 June 1974, the training commitment transferring to the Lightning Training Flight at Binbrook. The OCU later re-formed on Jaguars at Lossiemouth.

F.1
XM134
XM135
XM136
XM137
XM139
XM140
XM141
XM143
XM144
XM145
XM146
XM147
XM163
XM164
XM165
XM166
XM167

F.1A
XM171
XM172
XM173
XM174
XM177
XM178
XM180
XM182
XM183
XM184
XM188
XM189
XM192
XM213
XM214
XM215
XM216

F.3
XP696
XP707
XP737
XR716
XR718
XR7504XR751

T.4
XM968
XM969
XM970
XM972
XM973
XM974
XM987
XM988
XM9904XM994
XM996
XM997

T.5
XS416
XS417
XS418
XS419
XS420
XS421
XS422
XS423
XS449
XS450
XS451
XS452
XS453
XS454
XS455
XS457
XS458
XS459

Lightning Training Flight
The Lightning Conversion Unit (LCU) formed from C Flight of No.11 Squadron in September 1974, being renamed the Lightning Training Flight (LTF) during the following month. Following the reduction in training requirements for the dwindling Lightning fleet, the OCU at Coltishall was disbanded and conversion training on the Lightning was subsequently undertaken at Binbrook with the LTF. Training continued until 1 August 1987 when the LTF disbanded shortly before the final retirement of the two remaining operational squadrons.

F.3
XP694/A
XP706/DD
XP707/DB
XP741/DD/DA
XP749/A/DB/DA
XP750/B/DE
XP751/C/DB/DA
XP753/DC
XP764/B/DB/DC
XR713/S/DD/DC
XR716/D/C/DE
XR718/C/DC/DB/DE/DA
XR720/DA
XR749/DA
XR751/C/A/DA

T.5
XS416/V/DU
XS417/W/DZ
XS419/W/DW/DV
XS420/V/Y/DV
XS451
XS452/Z/DZ
XS456/T/DT/DX
XS457/Y
XS458/Z/DX/DY
XS459/X/DX/DW
XV328/Y/DY/DU

F.6
XR724/K
XR725/F/DF
XR726/DF
XR728/D
XR758/DF
XR773/DF
XS895/DF
XS923/DF
XS929/DG
XS936/DF

Lightning Augmentation Flight
Following the abandonment of plans to form a third operational Lightning squadron at Binbrook, The Lightning Augmentation Force was formed in 1981 to enable Lightning-qualified officers to maintain proficiency on the type whilst being assigned to ground tours, thereby reinforcing the RAF's wartime reserve capacity. No aircraft were officially assigned to the unit but a variety of aircraft were borrowed from the resident squadrons as required, or drawn from the fleet of stored aircraft held on the base. The LAF concept was successful but quickly abandoned as an economy measure.

F.3
XP694/A
XP702
XP749
XR713
XR749

F.6
XR725
XR726/F
XR757/Y
XR759
XR760/K

Binbrook Target Facilities Flight
Following the disbandment of the FCTU the Binbrook TFF was formed in 1966, operating F.1s XM164 and XM137. These aircraft (and subsequent deliveries) were used to provide the operational squadrons with supersonic/high speed targets for interception practice. Disbanding in December 1973 the TFF task was absorbed into the remaining operational squadrons.

F.1
XM137/Y
XM164/Z

F.1A
XM169/X
XM173/173
XM181/181
XM183/183

Wattisham Target Facilities Flight
Formed in April 1966 with three Lightning F.1As the TFF provided supersonic and high-speed targets for Wattisham's operational squadrons, remaining active until December 1973 when the TFF task was absorbed into the remaining operational squadrons.

F.1
XM136/B
XM139/A
XM144/B
XM147/C
XM163/A

In addition to wearing flamboyant LTF markings (which the aircraft still carries, on static display in Peterhead), XR749 also appeared in 56 Squadron markings during 1986 as part of that unit's anniversary celebrations. (Photo: Terry Senior)

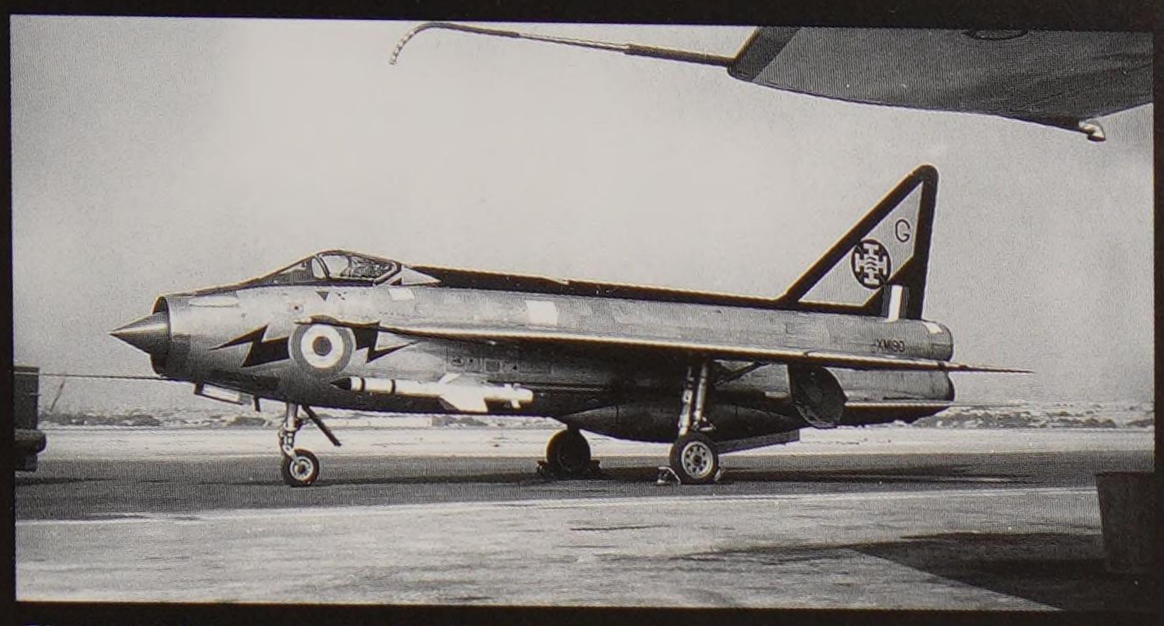
Having served with No.56 Squadron in Cyprus, T.5 XS452 was assigned to the Akrotiri Station Flight when the rest of the squadron returned to the UK and received what was probably the most bizarre paint scheme ever applied to a Lightning, with pink tail and nose bars (outlined in light blue), plus a flamingo motif on each side of the fin. The aircraft returned to the UK on 21 May 1975, suffering a brake 'chute failure upon landing at Binbrook. The aircraft was towed in from the runway with overheated brakes (covered in foam as can be seen) and the delightful paint scheme was not seen again, as the aircraft emerged from servicing in dark green camouflage. (Photo: Paul Tomlin)

Suitably posed for the media, a gaggle of 74 Squadron F.6s airborne from Leuchars prior to their departure to Singapore. (Photo: MoD)

Atmospheric view of two Lightning F.3s from No.74 Squadron overflying St.Andrews during their time at nearby Leuchars, shortly before re-equipping with F.6s and moving to Singapore. (Photo: MoD)

XP700 served with Nos. 74, 111 and 29 Squadrons during a brief service life which ended in August 1972 when the aircraft crashed in Suffolk following a take-off accident (the aircraft sank back onto the runway, rupturing the ventral tank). (Photo: Dennis Daws)

Although part of No.11 Squadron, XS899 carried the markings of No.92 Squadron during 1979 as part of the Lightning's 25th anniversary celebrations. It was the only F.6 ever to have carried this unit's markings and the only grey/green camouflaged aircraft to have been similarly marked. (Photo: Terry Senior)



Pictured at Luqa during No.111 Squadron's annual air defence exercise (based at Akrotiri), XM190 enjoyed only a brief service life, crashing on 1 April 1965 off Cromer, following an engine fire. (Photo: Richard Caruana)

T.Mk.4 XM997 illustrating the bright markings applied to the OCU's aircraft, enhanced by the addition of yellow bands intended to signify the T.4's training role, although the unit's single seaters were obviously used for the same purpose. The application of trainer markings on fighter aircraft was a relatively short-lived concept and was probably the result of official regulations rather than logic! (Photo: Tim McLelland collection)

No.111 Squadron operated only a few Lightning F.6s shortly before re-equipping with Phantoms and XS895 served with the unit for only five months. Pictured landing at Luqa during an exercise, the aircraft is fitted with a full ventral fuel tank fit instead of the usual Aden cannon. (Photo: Richard Caruana)

The eye-catching markings of the Lightning Training Flight on XR716 also reveal traces of a previous existence with No.56 Squadron, and (it would appear) a spell of activity with 5 Squadron. (Photo: Terry Senior)

Close-up look at the Lightning of 145 Squadron T.Mk.5 and the Red Top missile which was compatible with only the T.5 twin seaters (the T.4 being equipped only with Firestreaks). (Photo: Tim McLelland collection)

XR749 proudly displaying colourful markings applied in celebration of the Lightning Training Flight's 10th anniversary in 1986. (Photo: Terry Senior)

Nostalgic view of an OCU Lightning F.1A in the colours of 145 Squadron, recovering to Coltishall in 1967, brake 'chute streaming. XM173 eventually joined Binbrook's Target Facilities Flight and was used (having been withdrawn from flying duties) for camouflage paint trials in 1975, receiving a coat of dark grey paint. (Photo: David Taylor)

When the decision was made to apply camouflage to Gutersloh's Lightning fleet, the application of national insignia was also switched to 'low-visibility' and, thanks to some typically British red tape, even the unpainted aircraft received these markings, resulting in a few very bizarre temporary mixes of 'high viz' and 'low viz' Lightnings as illustrated by XM968. (Photo: Paul Tomlin)

F.1A
XM177
XM192

Leuchars Target Facilities Flight
Formed in April 1966 the TFF was equipped with three Lightning F.1As, providing supersonic and high speed targets for the operational squadrons based at Leuchars. The TFF task was assigned to No.23 Squadron in 1970 and the Flight officially disbanded in December 1973.

F.1
XM135/135
XM139/139
XM144/144
XM145/145
XM164/164

F.1A
XM173/173
XM174/174
XM177/177
XM178/178

Maintenance Units
No. 60 MU at Leconfield and 33 MU at Lyneham were both responsible for servicing, modifications and storage of Lightnings for many years and virtually all of the Lightning fleet was assigned to one (or both) of these units at various times. In order to maintain pilot proficiency, Lightnings were occasionally assigned to the units to act as continuation trainers for MU test pilots.

XR757 pictured at Binbrook whilst operating with the Lightning Augmentation Flight. The small dayglow orange LAF badge is visible on the tail fin together with a small 'zap' on the nose. (Photo: via Phil Elcock)

Although the Lightning Augmentation Flight had no specifically-assigned aircraft, a variety of aircraft were operated by the unit, either borrowed from the resident squadrons or taken from Binbrook's store. XR727 is pictured inside Binbrook's storage hangar after a period of service with the LAF, signified by the small dayglow marking on her tail fin. Of interest is the P.1A prototype tucked into the hangar prior to being transported to Cosford. (Photo: Terry Senior)

Although the Lightning Augmentation Flight did not officially operate its own aircraft, the unit borrowed aircraft from the Binbrook squadrons (or withdrew them from storage) as and when required. Consequently, some aircraft were given small LAF tail markings and codes, as illustrated by XR726/F. (Photo: terry Senior)

XP696 getting airborne in the hands of Peter Chapman at the 1974 International Air Tattoo, Greenham Common. (Photo: Dick Lohuis collection)

Lightning Production

The following tables provide details of each Lightning aircraft manufactured by English Electric. Although every effort has been made to include as much information as possible, some less significant allocations, accidents and movements have been omitted due to space limitations. However the most relevant details for each aircraft are specified and include details for unit allocations in chronological order. It should be noted that these details do not include the various periods when some aircraft were exchanged between units on a loan basis, and various exercises and deployments when some aircraft were temporarily re-assigned, and occasionally had temporary markings and codes applied.

P.1A

WG760
C/N 95001 ff R.P. Beamont 4.8.54. Initial handling and performance trials at Boscombe Down. Fitted with cambered wing leading edge modifications. To RAE 1958 for infra-red radiation trials. Last flight 18.2.61. Total flights 703, total hours flown 268.17. Dismantled 8.62. To Weeton as instructional airframe 7755M. To 4SoTT St Athan 9.65. To 71 MU Bicester 66. To Henlow for static display 6.67. To Binbrook 28.7.82 ASSF for refurbishment. To Royal Air Force Museum Cosford 30.1.86 for static display.

WG763
C/N 95003 ff R.P. Beamont 18.7.55. Developmental work at Warton. 250 gallon ventral tank modification and 2 x 30mm Aden cannon installation. Displayed at SBAC Farnborough 1955. To RAE Bedford Aero Flight, 21.6.57. Last flight 7.12.59 with a total of 133h. To Henlow 11.65 as 7816M for storage and static display 1976. To Museum of Science & Industry, Manchester on loan from RAF Museum.

WG765
C/N 95002 Structural test airframe at Warton.

P.1B

XA847
C/N 95004 ff R.P. Beamont 4.4.57. Handling trials, achieving Mach 1.2 on first flight and on 25.11.57 became first British aircraft to fly at Mach 2.0; commemorative fitted to aircraft. Aerodynamic trials and engine reheat trials at Boscombe Down. To A&AEE 13.7.60 for refuelling trials. Enlarged ventral tank fitted by Boulton Paul, Seighford 1960. Additional tail fin leading edge extension fitted. To Farnborough 21.4.66 completing 468 flights and 205.30 hours. Loose gravel over-run trials. To Henlow June 69 for storage. To RAF Museum Hendon 1972. Replaced by XS928 May 88 offered for disposal. Sold to Wensley Haydon-Baillie at Southampton. Sold to Marine Salvage 19.2.98. Sold to Howell family. On display Stowmarket 28.10.98.

XA853
C/N 95005 ff D. de Villiers 5.9.57. Aerodynamic and weapons trials Warton and Boscombe Down. Gun trials and gas concentration tests, first ground firing of Aden cannon 3.1.58. In-flight fire on flight 51 8.5.58. Stage 2 fin fitted and rear fuselage replaced. Four cannon installation 1960. Fin damage due to accidental canopy ejection 10.60. Last flight 3.5.63 with 153.25 hours. 296 flights. Ground trials at Boscombe Down including engine detuner tests. SOC 10.2.65. Front fuselage to ML Engineering 1.3.65, centre burned at Boscombe Down, wings returned to Warton for destruction tests. Scrapped at Warton.

XA856
C/N 95006 ff R.P. Beamont 3.1.58. To Rolls Royce for Avon development flying at Hucknall 24.3.58. On flight 35. Last flight 31.3.67 with 293 hours. Offered to Newark Air Museum but refused and scrapped at Hucknall late 1968.

Development Batch (P.1B standard).

XG307
C/N 95007 ff R.P. Beamont 3.4.58. First aircraft of 20 pre-production aircraft built at Samlesbury. Development work with EE, auto-stabiliser trials. To Boulton Paul for instrument fit 1962 as part of F3 programme. Auto attack system development 1963-65. Last flight 24.2.64 to A&AEE flight 238 with 276.10 hours. SOC 27.5.70 sold as scrap 19.6.70.

XG308
C/N 95008 ff R.P. Beamont 16.5.58. Development trials with EE. To A Squadron A&AEE Boscombe Down 12.58. Evaluated by USAF team 1958. Displayed SBAC Farnborough 9.58. Stall and spin trials at Warton 1960-61. Firestreak missile installation for spin trials. Last flight 29.6.66 to RAE Bedford with 187 hours and 362 flights. To Bedford dump 1972. Scrapped at Bedford.

XG309
C/N 95009 ff D. de Villiers 23.6.58. To A Sqn A&AEE 12.2.60 for Firestreak C(A) release trials. Red Top trials 1961-2. To Farnborough 5.2.64 for fin load measurement programme. To RAE Bedford 29.6.64 for fin load trials. Further fin trials at Bedford and later Warton until 6.66. To Farnborough 12.6.66. Last flight 23.6.66 with 230 hours. To Farnborough dump 1967. To R.J. Coley for scrap 27.6.68.

XG310
C/N 95010 ff J.W.C. Squier 17.7.58. EE ventral tank jettison trials and auto-ILS trials. Fitted with split flaps. To A Sqn A&AEE 21.12.59 for ILS assessment. Converted to F.Mk.3 standard by Boulton Paul, Seighford, 1961 for aerodynamic trials. Displayed as Mk.3 at SBAC Farnborough 9.62. To A Sqn A&AEE 17.12.62 for handling trials. Spinning and rolling trials with Red Top 1963-4. Landing accident with significant damage 25.6.64 last flight with 192.07 hours and 374 flights. Taxying trials at Warton prior to storage. Dismantled by 60 MU, transported to P&EE Foulness Island 3.7.68. Scrapped 1973. Mainplanes to Abingdon 11.77. Nose section sold as scrap Basildon 28.12.72.

XG311
C/N 95011 ff D. de Villiers 20.10.58. EE development work at Warton. To A Sqn A&AEE 26.1.60 for engineering trials. To Sydenham 8.5.61 for ship transfer to Aden. Khormaksar 27.8.61 for A&AEE tropical trials. To Sydenham by sea 11.61. To Warton 6.12.61. Target aircraft flights 1962-3. Landing gear failure 31.7.63. Aircraft abandoned test pilot Don Knight ejected. Crashed Ribble Estuary near Warton. Wreckage recovered to Warton. Total of 140.10 hours and 238 flights.

XG312
C/N 95012 ff J.W.C Squier 29.12.58. EE development work including first aerial firing of 4 x Aden cannon on flight 11. To Ferranti, Turnhouse 1960.64 for AI23/23B radar development. To Boulton Paul Seighford 3.61. To Ministry of Aviation Air Fleet, operating from Warton. 2-in rocket trials 1966. Last flight 12.10.66, windscreen shattered during flight at Mach 0.9 37,000 ft. Total of 303.53 hours and 429 flights. Dismantled by 60 MU and transported to P&EE Foulness Island 24.7.68. Scrapped 2.71. Starboard wing to RAE 3.71.

XG313
C/N 95013 ff R.P. Beamont 2.2.59. To de Havilland Hatfield for Firestreak trials. Displayed Le Bourget 6.69. To A Sqn A&AEE 21.12.60 for handling and performance trials. To Warton 4.5.62. To Hatfield 1962 for Firestreak development work. 2-in rocket trials at A&AEE 6.64. Last trials flight 14.12.67. Sold to Airwork Services, to Sydenham 25.4.68 on last flight (560) with 351.17 hours. Transported by sea to Saudi Arabia as G27.115. Stored until 4.69 then transferred to Dhahran for ground instructional use. Two-tone brown (blue undersides) camouflage trial application. Refurbished to unpainted display standard at Dhahran.

XG325
C/N 95014 ff J.W.C. Squier 26.2.59. To A Sqn A&AEE for radio trials. MoA aircraft. To de Havilland Hatfield for Firestreak development and Red Top trials. Last flight 26.10.64 to Warton with 221.02 hours and 282 flights. Dismantled by 60 MU, to P&EE Foulness Island 28.10.65. Scrapped 1979. Nose section to Wattisham 1972, donated to 1479 Sqn ATC Rayleigh. Loaned to Southend Museum and 1312 Sqn ATC. To 1479 Sqn ATC 6.94.

XG326
C/N 95015 ff P. Hillwood 14.3.59. Trials with EE including red oxide fuel studies. To A Sqn A&AEE 31.5.60 for radar and pilot attack sight trials. To Warton 20.11.63 for use as target aircraft. Last flight 12.10.66 with 416.02 hours and 551 flights. Dismantled by 60 MU and removed 10.6.68. Displayed Horse Guards Parade London for RAF 50th Anniversary. To P&EE Foulness Island 20.9.68. Scrapped 2.75, starboard wing to RARDE at Fort Halstead 1.76.

XG327
C/N 95016 ff J.W.C. Squier 10.4.59. To A Sqn A&AEE for handling trials and rocket pack development. Cat 4 damage on 59th flight, undercarriage retracted prematurely on take-off. To Warton by road 23.5.60. To Boulton Paul Seighford 1961 for installation of F.3 instrumentation. Camera fairing fitted to lower fuselage for sighting trials. To Warton 14.6.61. To A Sqn A&AEE 28.5.62 for preview of AI23B radar. Stage 3 fin fitted 1962. To A Sqn A&AEE 20.4.66 for 2-in rocket pack trials. To RAE Bedford 1969 for arrestor barrier trials. Last flight 2.9.69 with 214 hours. To 5 SoTT St.Athan 8.72 allocated 8188M. To Manston 23.4.77, outer wings and fin removed. Fire & rescue airframe. Fire training by 8.91. Remains sold to Hanningfield Metals 8.93.

XG328
C/N 95017 ff R.P. Beamont 18.6.59. To Boulton Paul Seighford 2.62 fitted with Stage 3 fin. F3 instrumentation fitted. OR946 auto attack system development. Red Top trials. To RAE Bedford 7.67. Last flight 20.1.66 with 127.37 hours and 220 flights. Stored at Warton. Transported to P&EE Foulness Island 7.8.68. Dismantled 3.75. Wings to RAE 3.71. Remainder sold as scrap West Bromwich 4.73.

XG329
C/N 95018 ff R.P. Beamont 30.4.59. Development work with EE, intensive gun firing trials. To A Sqn A&AEE 13.4.61 for sighting and gun firing trials. Black spine and fin leading edge paint scheme applied together with orange lightning flash. To Boulton Paul Seighford 29.8.61 for F3 instrumentation and fitting of Stage 3 fin. To Warton then A Sqn A&AEE 4.11.64 for data link trials. Tacan trials and Linesman ground control system trials. Allocated to chase duties with TSR2 programme and rumoured to have briefly worn an overall red paint scheme. To de Havilland Hatfield 6.4.66. To A Sqn A&AEE 21.12.66 for tacan trials. Last flight 2.6.69 with 315.30 hours. To Cranwell Engineering School allocated 8050M. To Swinderby (by Chinook) 23.9.86 for static display. Sold 1983 to Air Atlantique. To Norfolk & Suffolk Aviation Museum, Flixton 13.8.94.

XG330
C/N 95019 ff J.W.C. Squier 30.6.59. EE development work. OR946 and autopilot trials. To A Sqn A&AEE 4.10.60 for preview of air data system and flight control system for F.2. Further trials with A&AEE before permanently returning to Warton. Last flight 5.1.65 with 170.24 hours and 276 flights. Ground trials at Warton. OR339 weapons systems development and fire zone trials. Scrapped at Warton 1968, remains to Chorley 1970.

XG331
C/N 95020 ff J.W.C. Squier 14.5.59. Development work with EE. Engineering and operational reliability trials. Displayed SBAC Farnborough 959 in black spine and orange lightning flash paint scheme. To A Sqn A&AEE 23.12.59 for appraisal of engineering and operational reliability trials, returning to Warton for engineering work. To Warton 13.9.60 as part of F3 trials programme. To Boulton Paul Seighford

1961 for F3 instrumentation installation and Stage 3 fin fitment. To Warton 13.9.61 for AI23B/Red Top trials. Cat 3 damage following starter explosion. Last flight 28.9.66 with 196.14 hours and 290 flights. Dismantled and transported to P&EE Foulness Island 7.68. Fuselage scrapped 1973 to Basildon, wings surviving until 1981. Nose section to Dowty Rotol then to 2342 Sqn ATC Gloucester. To Gloucester Aviation Collection by 1.96.

XG332
C/N 95021 ff J.W.C. Squier 29.5.59. Development work with EE. Displayed at SBAC Show Farnborough 9.60. To de Havilland Hatfield 2.3.61 for Red Top development. Crashed 13.9.62. Engine fire and tailplane control rod failure, pitched-up out of control on final approach to Hatfield. Test Pilot George Aird successfully ejected at 150 ft. 138.52 hours and 214 flights. Remains removed to Croydon 1962.

XG333
C/N 95022 ff T.M.S. Ferguson 26.9.59. First aircraft fitted with liquid oxygen system. To A Sqn A&AEE 14.5.60 for UHF radio trials. To Sydenham 8.5.61 for shipment to Aden. A&AEE tropical trials at Khormaksar 1961. To Sydenham and then to Warton 14.8.63. Boeing rain repellent programme. Ventral tank jettisoned on flight 424 following fire warning, aircraft flown by USAF pilot. Last flight 14.2.68 with 293 hours. Sold as scrap 2.11.70. HH Bushell Ltd.

XG334
C/N 95023 ff J.W.C. Squier 14.7.59. To AFDS Coltishall (coded A) 23.12.59. Crashed following hydraulics failure 5.3.60 off Wells-next-the-Sea. Pilot Sqn Ldr Harding ejected safely. Wreckage recovered and transported to Warton. Total of 23.35 hours and 34 flights.

XG335
C/N 95024 ff T.M.S. Ferguson 7.8.59. To AFDS Coltishall (coded B) 19.1.60. Loaned back to EE then to A Sqn A&AEE 27.10.60 for tacan trials. To Boulton Paul Seighford for F3 instrumentation and fitment of stage 3 fin. To A Sqn A&AEE 12.11.62 for Red Top evaluation trials. Crashed 11.1.65 at Woodborough, Wiltshire following failure of undercarriage sidestay bracket. Pilot Sqn Ldr A.J. Whittaker ejected safely over Larkhill ranges. Total of 204.26 hours and 286 flights. SOC 31.12.65.

XG336
C/N 95025 ff J.W.C. Squier 25.8.59. To AFDS Coltishall (coded C) 19.1.60. Loaned back to EE then to A Sqn A&AEE 3.11.60 for clearance of PAS system. To Boulton Paul Seighford 1961 for F3 instrumentation fit and installation of Stage 3 fin. To A Sqn A&AEE 10.5.65 after Red Top trials. To conversion training programme at Boscombe Down 6.11.67. Red spine and fin paint scheme applied. Last flight 5.9.68 with 369.30 hours. To Operational Reliability Assessment Section 2.12.68. SOC 21.3.69. To 1 SoTT Halton 6.5.70 allocated 8091M. Scrapped at Halton 3.74.

XG337
C/N 95026 ff J.K. Isherwood 5.9.59. To A Sqn A&AEE 26.8.60 for auto-ILS and radio assessment. Fitted with plain flaps. To Boulton Paul Seighford for F3 instrumentation fit and Stage 3 fin installation. To Warton 31.8.62. AI23B radar and Red Top installation. To A Sqn A&AEE 27.6.63 for Red Top evaluation trials. Returned to Warton then back to A&AEE for further Red Top trials and Light Fighter Sight trials and continuation training flights. To Warton 4.3.69 on last flight with 477 hours and a total of 698 flights. To 2 SoTT Cosford 27.1.70 allocated 8056M. To Aerospace Museum then RAF Museum Cosford 13.12.83.

F.Mk.1

XM134
C/N 95030 ff R.P. Beamont 3.11.59. First production Lightning. To A Sqn A&AEE 31.3.60. To Handling Sqn. Warton 10.11.60 for development work and C(A) release programme. To 74 Sqn (coded A) Coltishall 2.9.63. To 226 OCU (coded 134) 15.6.64. Crashed off Happisburgh, Norfolk 11.9.64 following undercarriage malfunction during an air test. Pilot Flt Lt Terry Bond ejected safely at 10,000 ft. Remains recovered to Farnborough 10.64, rear fuselage to Warton. Total of 229.15 hours.

XM135
C/N 95031 ff T.M.S. Ferguson 14.11.59. To A Flt AFDS (coded D), detached to Leconfield 25.5.60. To Warton for modifications then 74 Sqn (B) 28.2.63. To 226 OCU (135) 30.7.64. To 33 MU Lyneham 13.1.65 for storage. Modified for target facilities role. Cat 3 damage 30.12.65. To Leuchars Tff 20.9.66. To 60 MU 29.6.71. Into storage then used for continuation training. Last flight to IWM Duxford 20.11.74 with 1343 hours. Restored in 74 Sqn colours.

XM136
C/N 95032 ff J.C. Hall 1.12.59. To A Flt AFDS (coded E), detached to Leconfield 21.6.60. Loaned to 74 Sqn then to Warton for modifications. To 74 Sqn (coded C) 1.5.63. To 226 OCU (136) 16.7.64. To 33 MU Lyneham for storage and modification to target facilities standard. To Wattisham Tff (B) 5.4.66. Crashed at Scottow on Coltishall's approach 13.9.67 following fire in rear fuselage, damaging the tailplane control rod. Pilot Flt Lt Jock Sneddon ejected safely. Wreckage to Farnborough 16.9.67 with 742 hours.

XM137
C/N 95033 ff J.K. Isherwood 14.12.59. To A Flt AFDS (coded F), detached to Leconfield 28.6.60. Loaned to 74 Sqn then to Warton for modifications. To 74 Sqn (coded D) 3.4.63. To 226 OCU (137) 20.5.64. To 33 MU Lyneham 9.2.65 for storage then conversion to target facilities standard. To Binbrook 15.3.66 to FCTU (coded Y). Binbrook Tff (Y) 28.7.67 operated by 5 Sqn. Rear fuselage fire discovered and returned to Warton by road. To 60 MU 18.1.71. Diverted to Finningley with fire warning during air test 20.8.71. Temperature trials with 60 MU Leconfield 3.73 (winged bell motif on fin). To Leconfield dump 11.74. Sold as scrap, Siddal, 12.74 with 766.25 hours.

XM138
CN/ 95034 ff J.K. Isherwood 23.12.59. To A Flt AFDS (coded G), detached to Leconfield 30.6.60. Engine fire on landing at Coltishall 16.12.60. Dismantled and transported to Warton 31.8.61 with 74.35 hours. Nose section to Coltishall 10.66 then to Farnborough firing range 1972. Sold as scrap Siddal 9.75.

XM139
C/N 95035 ff D. de Villiers 12.1.60. To 74 Sqn Coltishall (coded C) 2.8.60. To Warton for modifications then to 74 Sqn (F) 21.6.63. To 226 OCU (139) 21.4.64. To 33 MU Lyneham for storage and modification to target facilities standard. To Leuchars Tff 28.4.66. Cat 4 fuel pump problems necessitating wing change. To Wattisham Tff (A) 19.2.70. Solo display aircraft for 1970 SBAC show and 1971 Paris show. Last flight 4.74 with 1893 hours. Allocated 8411M to decoy duties at Wattisham. To Pendine by road 27.8.86. Sold as scrap to Birds Commercials, Long Marston 3.94.

XM140
C/N 95036 ff D. de Villiers 25.1.60. To 74 Sqn Coltishall (coded M) 2.8.60. Cat 3 engine fire 3.4.63. To Leconfield 8.7.63. To 226 OCU (140) 20.8.63. To 111 Sqn (coded R) 10.7.64. To 33 MU Lyneham for storage 1.1.65, last flight with 435 hours. Scrapped at Lyneham 11.66 and sold to B.A. Taylor, Bromwich.

XM141
C/N 95037 ff J.C. Hall 9.2.60. To 74 Sqn (coded D) 29.8.60. Cat 3 damage to fin resulting from close formation flying at Coltishall, subsequently leading to strengthening of all Lightning fins. To Leconfield 2.7.63. To 33 MU Lyneham 10.2.65 for storage, last flight with 399 hours. Scrapped at Lyneham and sold to B.A. Taylor, Bromwich 11.66. Fuselage to Warton, sold as scrap 1.72.

XM142
C/N 95038 ff T.M.S. Ferguson 19.2.60. To 74 Sqn (coded B later D) 30.8.60. Crashed 24.4.63 following hydraulic failure. Pilot Flt Lt Jim Burns ejected safely inland while the aircraft crashed in the sea off Overstrand, Norfolk with 418 hours.

XM143
C/N 95039 ff J.K. Isherwood 27.2.60. To 74 Sqn (coded A) 15.9.60. To Modification Centre Leconfield 13.6.63. To 226 OCU (143) 12.8.63. To 33 MU Lyneham for storage 15.1.65, last flight with 557 hours. Scrapped at Lyneham, sold to B.A. Taylor, 11.66.

XM144
C/N 95040 ff T.M.S. Ferguson 14.3.60. To 74 Sqn (coded J) 30.9.60. To Warton for modifications 10.12.62. To 74 Sqn (G) 24.5.63. To 226 OCU (144) 19.6.64. Cat 3 damage 29.9.64 nose gear locked up. To 33 MU Lyneham for storage 17.6.65, modified to target facilities role. To 60 MU Leconfield 4.7.66. To Leconfield Station Flight 1.67, painted in 'Golden Arrow' markings. To Wattisham Tff (B) 1.1.68. Named 'Jinx' subsequently 'Felix'. To 60 MU 22.9.70. To Leuchars Tff 29.7.71. To 23 Sqn (X) 27.3.73. Last flight 7.11.73 with 1564 hours. GIA airframe at Leuchars allocated 8417M. Refurbished and positioned as gate guard. Removed 9.89. To private owner, Burtwood, 1992. Nose section to South West Aviation Heritage, Eaglescott Airfield. To Wycome Air Park later Pershore, then to private owner Neil Airey (Lakes Lightnings) in Cumbria.

XM145
C/N 95041 ff D. de Villiers 18.3.60. To 74 Sqn (coded Q) 14.5.62. To Warton for modifications then to 74 Sqn (H) 13.2.63. To 226 OCU (145) 3.6.64. To 33 MU Lyneham for storage and modifications to target facilities standard. To Leuchars Tff 26.4.66. To 60 MU Leconfield for storage 24.1.72, last flight with 876 hours. To Leconfield dump 6.74, sold as scrap to Shackletons, Siddal, 11.74.

XM146
C/N 95042 ff J.C. Hall 29.3.60. To 74 Sqn (coded L) 4.9.60. To Modification Centre Leconfield 21.6.63. To 226 OCU (146) 30.7.63. To 111 Sqn (J) 13.7.64. To 33 MU Lyneham 1.1.65 for storage, last flight with 557 hours. Sold as scrap to B.A. Taylor, Bromwich, 11.66.

XM147
C/N 95043 ff T.M.S. Ferguson 7.4.60. To 74 Sqn (coded P) 3.10.60. To Warton for modifications 6.12.60 and 2.12.62. To 74 Sqn (J) 6.6.63. To 226 OCU (147) 7.5.64. On loan to Warton 12.1.65 for undercarriage failure investigations. To 33 MU Lyneham 28.4.65 for storage and modification to target facilities role. To Wattisham Tff (coded C) 16.5.66. Cat 3 fuel leak leading to wing replacement. To Wattisham Tff (A) named 'Felix' 9.6.67. Uncoded named 'Korky' 12.69. To GIA at Wattisham 28.5.74 allocated 8412M with 1648 hours. Airfield decoy. Transported to Pendine 27.8.86. Fin retained for display at Wattisham. Airframe sold as scrap to Birds Commercials, Long Marston 3.94.

XM163
C/N 95044 ff D. de Villiers 23.4.60. To AFDS (coded H) 4.11.60 but returned to Warton. To Fighter Command Reserve, Coltishall 7.11.60, on loan to AFDS 14.11.60. Loan to 74 Sqn (Q) 7.61. To Warton for modifications then to 74 Sqn (K) 3.4.63. To 226 OCU (163) 13.7.64. To 33 MU Lyneham 24.4.65 for storage and modification to target facilities standard. To Wattisham Tff (A) 29.3.66. To 60 MU Leconfield for storage 16.2.72, last flight with 865 hours. To Leconfield dump 5.74. Sold as scrap to Shackletons, Siddal, 11.74.

XM164
C/N 95045 ff D. de Villiers 13.6.60. To 74 Sqn (coded K) 15.7.60. To Warton for modifications, then to 74 Sqn (L) 8.7.63. To 226 OCU (164) 9.6.64. To 33 MU Lyneham 25.3.65 for storage and modification to target facilities standard. To FCTU Binbrook (coded Z) 23.2.66. Binbrook Tff (Z) 28.7.67 operated by 5 Sqn. To 60 MU Leconfield 16.9.68. To Leuchars Tff (coded S then 164) 29.6.71. To 60 MU Leconfield for storage 24.3.72. Last flight 5.72 with 878 hours. To Leconfield dump 6.74. Sold as scrap to Shackletons, Siddal, 11.74.

XM165
C/N 95046 ff R.P. Beamont 30.5.60. To 74 Sqn (coded F) 29.6.60. To Modification Centre Leconfield 9.7.63. To 226 OCU (165) 6.9.63. To 33 MU Lyneham for storage 2.9.64, last flight with 532 hours. Sold as scrap to B.A. Taylor, Bromwich, 11.66.

XM166
C/N 95047 ff T.M.S. Ferguson 1.7.60. To 74 Sqn (coded G) 2.8.60. To Leconfield Modification Centre 14.6.63. To 226 OCU (166) 30.7.63. To 33 MU Lyneham for storage 2.4.65, last flight with 610 hours. Sold as scrap to B.A. Taylor, Bromwich, 11.66.

XM167
C/N 95048 ff J.C. Hall 14.7.60. To 74 Sqn (coded H) 26.9.60. To Leconfield Modification Centre 27.6.63. To 33 MU Lyneham for storage 2.4.65, last flight with 525.55 hours and 681 flights. Nose section to A&AEE, wing box transported to Warton. Remains sold as scrap to B.A. Taylor, Bromwich, 11.66.

XM168
C/N 95049 Structural test airframe retained at Warton.

F.Mk.1A

XM169
C/N 95056 ff R.P. Beamont 16.8.60. Retained by EE for flight refuelling trials. A Sqn A&AEE 22.7.61. To 111 Sqn (B) 14.10.64. To 56 Sqn 18.2.65. 33 MU Lyneham 12.4.65. 60 MU Leconfield 9.8.66. To Binbrook Tff (X) 23.1.68. To 5 Sqn (X) 6.70 then Tff 1.10.72. To 23 Sqn (W) Tff 3.9.73. Final flight 3.1.74 with 812 hours. To Leuchars BDRF allocated 8422M. Sold to Calverts as scrap and removed 8.89, nose section to Ken Ward, Chop Gate, Yorks.

XM170
C/N 95057 ff J.K. Isherwood 12.9.60. Mercury contamination during assembly. WFO with only 14 minutes flying time. To 9 SoTT Newton 18.3.65 allocated 7877M. To St.Athan then Swinderby 12.66. To dump, destroyed 1976.

XM171
C/N 95058 ff 20.9.60 R.P.Beamont. A Sqn A&AEE for evaluation and handling trials. To Warton then 56 Sqn (coded R) 28.2.61. First service aircraft to be fitted with a refuelling probe. To 56 Sqn (A) 'Firebirds'. To 226 OCU (171) 7.4.65. To 60 MU 12.9.73 then returned to OCU. Final flight to 60 MU 12.9.73 with 2232 hours. To Leconfield dump 3.74, sold to Shackletons as scrap 29.3.74.

XM172
C/N 95059 ff J.K. Isherwood 10.10.60. 56 Sqn (S) 14.12.60. Recoded (B) 'Firebirds' team. To 226 OCU (172) 3.5.65. To 60 MU then returned to OCU 11.66. Final flight 6.74 with 2083 hours. To Coltishall, allocated 8427M. Sold to Wensley Haydon Baillie, retained on display at Coltishall. Sold to Park House Aviation 17.11.99, to Wycombe Air Park and subsequent display nr. Farnborough DERA site.

XM173
C/N 95060 ff J.K. Isherwood 1.11.60. 56 Sqn (V) 2.1.61. To 'Firebirds' team (recoded C). To 226 OCU (173) 10.2.65. To 60 MU 29.7.65 returning to OCU. To Leuchars Tff (173) 31.12.71. To 23 Sqn Tff 27.3.72. To Binbrook Tff 29.3.72. To GIA use 28.5.74 with 2142 hours, allocated 8414M. Camouflage paint trials 1975. To Bentley Priory 11.76 on display.

XM174
C/N 95061 ff J.K. Isherwood 15.11.60. 56 Sqn (Y) 15.12.60. To A&AEE for weapons trials then 56 Sqn (D) 'Firebirds' 2.63. To 226 OCU (174) 28.6.65. To Leuchars Tff (174) 15.10.68. Crashed near Leuchars 29.11.68 following reheat fire. Pilot E.Rawcliffe ejected safely. 1262.25 hours. Wreckage recovered to Leuchars.

XM175
C/N 95062 ff D. de Villiers 23.11.60. 56 Sqn (T) 21.12.60. Recoded (E) 'Firebirds' team. To 33 MU Lyneham for storage 20.4.65. To 60 MU reconciled for storage 25.7.66. To Warton by road 5.4.73 with 770 hours. Stress and corrosion tests. Scrapped on site 1974.

XM176
C/N 95063 ff J.K. Isherwood 1.12.60. 56 Sqn (D) 16.1.61. Recoded (F) 'Firebirds' team. To 33 MU Lyneham for storage 12.5.65. To 60 MU Leconfield 25.7.66. To dump 4.74, sold to Shackletons as scrap 7.74.

XM177
C/N 95064 ff R.P. Beamont 20.12.60. 56 Sqn (N) 28.2.61. Recoded (G) 'Firebirds' team. To 226 OCU (177) 3.3.65. To 60 MU 22.3.66 returning to OCU. To Leuchars Tff (177) 16.10.69. To Wattisham Tff 23.4.71. Leuchars Tff and 23 Sqn (Y) during 1972 then returning to Wattisham Tff. Displayed at SBAC Farnborough show 1972. To 60 MU 14.9.73 for storage. Final flight with 2240 hours. To reconciled dump 3.74, sold as scrap to Shackletons 8.74.

XM178
C/N 95065 ff J.K. Isherwood 30.12.60. 56 Sqn (O) 3.2.61. Recoded (H) 'Firebirds' team. To 33 MU Lyneham 28.6.65. To 226 OCU (178) 20.6.66. To 60 MU Leconfield 23.12.66 returning to OCU. To Leuchars Tff (178) 14.2.72. To 23 Sqn (Y) Tff 27.3.72. Final flight 1.74 with 1378 hours. GIA at Leuchars, airfield decoy 28.5.74. Allocated 8418M BDRT. Sold and removed to Savigny-le-Beaune, France, for museum display 13.10.89.

XM179
C/N 95066 ff D. de Villiers 4.1.61. 56 Sqn (F) 28.2.61. To Middleton St. George 12.12.61 for servicing training. To 56 Sqn 19.2.62, recoded (J) 'Firebirds' team. Crashed near Wattisham 6.6.63 following collision with XM181. Pilot Mike Cooke ejected but injured. 353 hours.

XM180
C/N 95067 ff D. de Villiers 23.1.61. 56 Sqn (H) 8.3.61. Recoded (K) 'Firebirds' team. To 226 OCU (180) 18.2.65. To 60 MU Leconfield 13.10.65 then returned to OCU. To Gutersloh 10.7.74 with 1887 hours. Allocated 8424M, airfield decoy. Sold and scrapped 26.10.82.

XM181
C/N 95068 ff R.P.Beamont 25.1.61. 56 Sqn (X) 26.9.61. To 111 Sqn (M) 25.4.62. To 56 Sqn (L) 'Firebirds' team 7.3.63. Following collision with XM179 to 33 MU then 60 MU for storage 17.8.66. To Binbrook Tff 4.5.70. To GIA duties Binbrook 28.5.74 allocated 8415M. Camouflage paint trials 1975. BDRT (8). Sold to R. Austin as scrap, removed 25.9.87.

XM182
C/N 95069 ff T.M.S. Ferguson 6.2.61. 56 Sqn (P) 13.3.61. Recoded (M) 'Firebirds' team. To 226 OCU (182) 15.2.65. To 60 MU 28.6.65 then returned to OCU. To 23 Sqn Tff 5.7.73. To 226 OCU (182) 25.7.73. To Gutersloh 10.7.74, final flight with 2279 hours. Allocated 8425M. Airfield decoy. Sold and scrapped 26.10.82.

XM183
C/N 95070 ff R.P. Beamont 9.2.61. 56 Sqn (K) 6.3.61. Recoded (N) 'Firebirds' team. To 33 MU for storage then 226 OCU (183) 23.6.66. To 5 Sqn (X) Tff 12.10.71. Binbrook Tff (183) 1.10.72. GIA 28.5.74 allocated 8416M with 1477 hours. Camouflage paint scheme trials 1975. Airfield decoy (7). Sold as scrap to W. Whatnell, removed 31.1.88.

XM184
C/N 95082 ff T.M.S. Ferguson 27.2.61. 111 Sqn (A) 13.4.61. To 60 MU then 226 OCU (184) 19.3.65. Landing accident (fire) 17.4.67. SOC 4.5.67 with 1014 hours. To Coltishall dump, destroyed 1977.

XM185
C/N 95083 ff J.K. Isherwood 27.2.61. 111 Sqn (coded C) 30.3.61. Crashed near Rattlesden airfield, Suffolk 28.6.61 following undercarriage extension failure. Pilot Pete Ginger ejected safely. 32.25 hours. Wreckage recovered and scrapped.

XM186
C/N 95084 ff T.M.S. Ferguson 14.3.61. 111 Sqn (B) 13.4.61. Crashed near Wittering 18.7.63 during aerobatic sequence take-off. Pilot A.Garside ejected late and was killed. 420.46 hours. Wreckage recovered.

XM187
C/N 95085 ff de Villiers 20.3.61. 111 Sqn (D) 24.4.61. Landing accident at Wattisham 19.11.63, pilot M.R.Smith injured. Allocated 7838M with 509 hours. To 9 SoTT Newton 28.2.64. To Coningsby dump 11.78, destroyed.

XM188
C/N 95086 ff J.K. Isherwood 27.3.61. Evaluation flights (SAAF pilots) prior to delivery. To 111 Sqn (F) 31.5.61. To 226 OCU (188) 18.1.65. Ground accident (ran into hangar) at Coltishall 21.6.68. SOC 4.7.68 with 1397 hours. To Coltishall dump 20.11.68, destroyed 1977.

XM189
C/N 95087 ff D. de Villiers 30.3.61. 111 Sqn (E) 1.5.61. Take-off accident at Wattisham 18.1.62 (ran off runway at night). To 226 OCU (189) 1.2.65. To 60 MU 23.11.66 returned to OCU. To Gutersloh 10.7.74 with 1928 hours. Airfield decoy allocated 8423M. Sold as scrap 26.10.82 and removed.

XM190
C/N 95088 ff T.M.S. Ferguson 1.5.61. 111 Sqn (G) 20.6.61. Evaluation flights (Indian AF) post delivery. To 226 OCU (190) 1.4.65. Crashed North Sea off Cromer 15.3.66 following engine fire. Pilot Al Peterson (USAF) ejected safely. 854 hours. Wreckage recovered to Gorleston then Coltishall.

XM191
C/N 95089 ff T.M.S. Ferguson 8.5.61. 111 Sqn (H) 28.6.61. Landed with engine fire at Wattisham 9.6.64. SOC with 557 hours. Nose section allocated 7854M. To 71 MU Abingdon for travelling display unit. Remainder of aircraft scrapped at Wattisham via dump.

XM192
C/N 95090 ff J.K. Isherwood 25.5.61. 111 Sqn (K) 28.6.61. To 226 OCU (192) 14.1.65. To Wattisham Tff 2.10.69. Withdrawn with 2186 hours. GIA at Wattisham, allocated 8413M. On display as gate guard 27.9.74. Used as reference for Airfix plastic model kit. Sold to Charles Ross, transported to Binbrook village then Hemswell. On display, Thorpe Camp, Lincolnshire.

XM213
C/N 95091 ff J.K. Isherwood 3.6.61. 111 Sqn (L) 30.6.61. To 226 OCU (213) 5.4.65. WFU after take-off accident (sank back onto runway) at Coltishall 6.5.66. 886 hours. Removed as scrap 31.5.67.44.

XM214
C/N 95092 ff J.K. Isherwood 29.6.61. 111 Sqn (N) 1.8.61. To 226 OCU (213) 9.4.65. Displayed Paris show 1969. Delivered to Gutersloh 15.6.74 with 2254 hours. Allocated 8420M. Airfield decoy. Scrapped and removed 1977.

XM215
C/N 95093 ff D. de Villiers 11.7.61. 111 Sqn (coded C) 2.8.61. To 226 OCU (215) 8.2.65. Displayed Paris show 1969. Delivered to Gutersloh 14.6.74 with 2201 hours. Allocated 8421M. Airfield decoy. Scrapped and removed 1977. Nose section to Bruggen (BDRT), scrapped 1984.

XM216
C/N 95095 ff T.M.S. Ferguson 28.7.61. 111 Sqn (P) 29.8.61. To 226 OCU (216) 15.1.65. Delivered to Gutersloh 10.7.74 with 2110 hours. Allocated 8426M. Airfield decoy. Scrapped 1977.

T.Mk.4

XL628
C/N 95049 ff R.P. Beamont 6.5.59. Prototype T.4. Retained by EE Warton for trials and development. Appeared at 1959 SBAC Farnborough show. Crashed 1.10.59 during high speed flight over Irish Sea. Tail fin suffered structural failure. Test pilot J.W.C. Squier became first person to eject from a British aircraft flying in excess of Mach One. 94th flight, 40.41 hrs flown.

XL629
C/N 95050 ff R.P. Beamont 29.9.59. Second prototype T.4. Retained by EE Warton for development and trials work. To A Sqn A&AEE 13.6.60 for T.4 preview assessment. Appeared at 1960 SBAC Farnborough show. To ETPS Farnborough 13.5.66. To Boscombe Down 20.12.67 (coded 23). To Warton 31.10.69. Chase aircraft for Jaguar programme. To ETPS 6.5.70. Last flight 3.11.65 with 1383.55 hours. Boscombe Down gate guard 11.11.75. Currently on plinth at gate.

XM966
C/N 95051 ff R.P. Beamont 15.7.60. A Sqn A&AEE 16.3.61, handling and engineering trials. To BAC Filton for conversion to T.5 standard 19.9.61. ff as T.5 1.12.62, flown to Warton by J.Dell. Appeared at 1963 Paris show. To A Sqn A&AEE 23.7.64 for performance trials. To Warton 2.11.64 for 2-in rocket trials. Crashed 22.7.65 on high speed test flight over the Irish Sea following structural failure of tail fin. Pilot Jimmy Dell and Flight Test Engineer Graham Elkington ejected safely. 263 flights and 152.51 hours.

XM967
C/N 95052 ff J.L. Dell 30.3.62. Produced as a T.4 but taken by road to Filton for conversion to T.5 standard prior to completion. Displayed at SBAC Farnborough show 1962. To Warton 19.4.63 for aerodynamic test flights. To A Sqn A&AEE 24.6.64 for rolling clearance flights. To RAE Farnborough 22.5.68. To Warton 14.11.69 for refurbishment. Fitted with instrumented tail fin. To RAE Farnborough 3.70. With 263 hours. To Honington for fire/rescue practice but transferred to Colerne 5.1.75 for preservation, allocated 8433M. To Kemble 7.76, to fire dump 12.76.

XM968
C/N 95053 ff R.P. Beamont 9.11.60. To A Sqn A&AEE 1.6.61 for armament and performance trials. To Warton 12.7.62. Transferred to MoA and to A&AEE 28.8.63 for wet runway trials. TSR2 chase aircraft 9.64.2.65. To 60 MU Leconfield 14.5.65. To 226 OCU (968) 9.3.66. To 92 Sqn (Q) 27.1.72. Crashed 24.2.77 near Gutersloh following hydraulic failure with 1908 hours. Crew ejected safely.

XM969
C/N 95054 ff J.L. Dell 28.3.61. A Sqn A&AEE 15.6.61 for performance trials. To Warton 6.7.61 retained by EE for development trials. To LCS (H) 29.6.62. To 60 MU 1.4.63. To LCH (H) 28.5.63. To 226 OCU (969) 6.63. On loan to 92 Sqn 7.10.69. To Binbrook 19.6.74 for crash/rescue training allocated 8592M. Destroyed by 1988.

XM970
C/N 95055 ff T.M.S. Ferguson 5.5.61. To LCS (G) 2.11.61. First T.4 delivered to RAF. To Warton 23.11.61 for mods following failure of acceptance flights. Displayed at Paris show 1962. To LCS (G) 16.6.62. To 226 OCU (970) 6.63. To 60 MU for storage 12.7.74. Retained by 60 MU for continuation training. To 19 Sqn 13.1.76. Green camouflage (T) by 7.76. SOC 1.1.77 with 1968 hours. To Bruggen as instructional airframe and airfield decoy allocated 8529M. Scrapped 1992.

XM971
C/N 95071 ff J.K. Isherwood 23.6.61. LCS (K) 23.7.62. On loan to 92 Sqn 22.3.63. To 226 OCU (971) 6.63. Crashed 2.1.67 near Tunstead, Norfolk, engine failure following ingestion of debris from damaged intake bullet. Pilots Terry Carlton and Tony Gross ejected safely. Total of 688.30 hours. Wreckage to Coltishall, sold as scrap 31.5.67.

XM972
C/N 95072 ff D. de Villiers 29.4.61. To LCS (J) 2.7.62. To 19 Sqn 30.11.62. Modification centre Coltishall 7.1.63. To 226 OCU (972) 6.63. Rudder lost in flight 7.3.67, landed at Coltishall. To 60 MU 10.7.67. To 226 OCU (972) 15.2.68. Waddington for fire/rescue training 11.6.74 with 2012 hours. Destroyed 1981.

XM973
C/N 95073 ff T.M.S. Ferguson 17.5.61. AFDS Coltishall 3.8.62. Undercarriage failure at Binbrook 22.1.63. Retained at Binbrook by AFDS 24.5.63. To 226 OCU (973) 22.11.63. To 111 Sqn (T) 1.1.64. CFE Binbrook 31.7.64. 23 Sqn 8.9.64. To 60 MU 7.11.64. 23 Sqn (Z) 31.12.64. 226 OCU (973) 31.1.66. To 60 MU for storage and servicing 13.10.71. 19 Sqn (V) 29.9.72. Green camouflage by 1975. SOC with 1700 hours allocated 8528M. To Bruggen as airfield decoy. Scrapped 1992.

XM974
C/N 95074 ff T.M.S. Ferguson 19.6.61. Displayed at SBAC Farnborough show 1961. To 74 Sqn (T) 3.8.62. To 226 OCU (974) 7.2.66. 60 MU 4.7.66. 226 OCU (974) 5.10.66. Crashed 14.12.72 35 miles off Happisburgh, Norfolk with 1753 hours, following engine fire. Pilots J.Spencer and Evans ejected safely.

XM987
C/N 95075 ff T.M.S. Ferguson 13.7.61. LCS 20.8.62. Modification centre Coltishall 1.3.63. To 226 OCU (987) 6.63. 60 MU 25.3.66. 226 OCU (987) 7.5.69. To Coningsby 6.74 with 1908 hours for crash/rescue training. Grey/green camouflage applied, assigned to airfield decoy duties. To fire dump 1989, sold as scrap to Hanningfield Metals 4.2.92.

XM988
C/N 95076 ff T.M.S. Ferguson 21.8.61. Retained by EE Warton for development and trials, assigned to TSR2 programme to investigate low level routes. To 19 Sqn (O) 11.10.62. Modification centre Coltishall 15.11.62. 19 Sqn (T) 20.2.63. 74 Sqn (T) 9.9.63. On loan to 92 Sqn 13.2.64. 226 OCU (988) 4.3.64. Crashed in North Sea after entering spin 5.6.73 with 1600 hours. Pilot C. Bruce ejected safely.

XM989
C/N 95077 ff T.M.S. Ferguson 30.8.61. A Sqn A&AEE 22.2.62. Low flying route trials. To 56 Sqn (Z) 5.9.62. Modification Centre Coltishall 2.11.62. 56 Sqn (X) 18.1.63. Sold to BAC and returned to Warton 6.4.66. Converted to T.54 standard for Saudi Arabia as 54-650. Delivered via Cyprus arriving 16.6.66. 6 Sqn RSAF (607). Final flight 4.72 with 940 hours. On plinth for display at Dhahran.

XM990
C/N 95078 ff R.P. Beamont 21.9.61. LCS 20.9.62. To 226 OCU (990) 18.6.63. 60 MU Leconfield 14.2.67. 226 OCU (990) 12.7.67. Crashed 19.9.70 South Walsham, Norfolk with 1282 hours following loss of control during display at Coltishall. Pilots B.Fuller and J.Sims ejected safely. Remains to Coltishall dump 10.70.

XM991
C/N 95079 ff R.P. Beamont 4.10.61. LCS 20.9.62. To 226 OCU (991) 6.63. Modification Centre Leconfield 19.7.63. 19 Sqn (T) 24.9.63. Damaged at Gutersloh and SOC 30.10.75 with 1634 hours. Allocated 8456M. Scrapped on site.

XM992
C/N 95080 ff R.P. Beamont 13.12.61. To 111 Sqn (Z) 44.9.62. Modification Centre Coltishall 9.11.62. To 19 Sqn 19.12.62. To 111 Sqn (Z) 26.3.63. Canopy blown off on ORP by jet blast 23.6.64, flown to Leconfield 7.7.64 without canopy. Sold to BAC and returned to Warton 7.4.66. Converted to T.54 standard for RSAF as 54-651. Delivered via Cyprus arriving 11.6.66. To 6 Sqn (608). Last flight 4.72 with 788 hours. Abandoned at Khamis Mushayt, later removed possibly to Riyadh.

XM993
C/N 95100 ff J.K. Isherwood 9.12.61. LCS 4.10.62. Landing accident at Middleton St. George 12.12.62, port main wheel leg failed, pilots escaped on ground. SOC 14.12.62 with 42 hours. Componets retained for instructional use, rear fuselage to St.Athan.

XM994
C/N 95101 ff D. de Villiers 12-3.62. 19 Sqn 6.11.62. To LCS 22.2.63. 226 OCU (994) 27.6.63. Damaged 18.1.74 and transported to West Raynham for crash/rescue training with 1949 hours. Sold as scrap to Birds Commercial in 1977.

XM995
C/N 95104 ff D. de Villiers 25.1.62. 19 Sqn 29.11.62. Modification centre Leconfield 27.3.63. To 92 Sqn (T) 1.12.69. Green camouflage applied by 1975. SOC 6.4.77 and transferred to Wildenrath as airfield decoy allocated 8542M with 2121 hours. Scrapped 4.91.

XM996
C/N 95103 ff T.M.S. Ferguson 13.4.62. LCS 8.1.63. To 226 OCU (996) 10.7.63. SOC 2.7.74 and transferred to Machrihanist for crash/rescue training with 1898 hours. To dump 1976, destroyed 1979.

XM997
C/N 95111 ff D. de Villiers 22.5.62. LCS 14.1.63. 226 OCU (997) 6.63. 92 Sqn on loan 18.7.63. 226 OCU (997) 4.10.63. To 60 MU for storage 8.7.74 with 2133 hours. Allocated to crash/rescue training at Leconfield 22.11.74. To Catterick 12.76, destroyed and removed 1990.

F.Mk.2

XN723
C/N 95096 ff J.L. Dell 11.7.61. A Sqn A&AEE 6.2.62 for appraisal and CA Release. To EE Warton 14.5.62. To Rolls Royce Hucknall 2.4.63 with MoA on loan for engine development work. Crashed at Keyham, Leicestershire 25.3.64 with 104 hours following engine bay fire. Test pilot Dennis Whitham ejected safely.

XN724
C/N 95094 ff T.M.S. Ferguson 11.9.61. A Sqn A&AEE 22.5.62 for CA Release trials. To Warton 20.8.62. 33 MU Lyneham 5.9.63 for storage. To Warton for conversion to F.2A standard 20.10.66. To 19 Sqn (F) 18.5.68. WFU 7.12.76 with 2057 hours. Airfield decoy at Laarbruch allocated 8513M, later assigned to battle damage repair coded (BDR1). Bought by Solair UK 4.85 and removed. Status unknown but assumed scrapped.

XN725
C/N 95097 ff J.L. Dell 31.3.62. Completed to partial F3 standard with Avon 301 engines. Assigned to flight trials, carried overwing tanks on test flights and dummy Bullpup missile fit. To Filton 3.9.63 for fitment of cambered leading edge wing. To Warton 1.4.64. Arrestor hook trials. To RAE Bedford 30.1.67 assigned to Concorde noise and high speed trials. Warton 9.10.67 then RAE 26.4.68 Concorde trials. WFU 7.71 with 222 hours. By road to P&EE Foulness Island 13.9.74. Scrapped 10.85.

XN726
C/N 95098 ff J.K. Isherwood 29.9.61. AFDS (K) 14.2.63. To 33 MU Lyneham for storage 10.6.64. To Warton 19.10.66 for conversion to F.2A standard. 19 Sqn (D) 6.68. To Warton by road 26.5.72 following lightning strike. To 92 Sqn (N) 13.5.74. To RAE Farnborough 4.4.77, last flight with 2222 hours. Allocated 8545M, transported to P&EE Foulness Island 23.11.78. Scrapped 2.96. Nose section preserved at Boscombe Down.

XN727
C/N 95099 ff D. de Villiers 13.10.61. 19 Sqn (A) 25.1.63. To Warton for conversion to F.2A standard 25.4.69. To 92 Sqn (P) 3.2.70. To Warton 6.7.70 then 60 MU Leconfield 22.9.70. 92 Sqn (W) 3.12.70. Mid-air collision with XN774 16.9.71. Returned to flying duties, SOC 1.4.77 and flown to RAE Farnborough 4.4.77 with 3056 hours. Allocated 8547M, transported to P&EE Foulness Island 20.4.78. Scrapped 3.82.

XN728
C/N 95105 ff T.M.S. Ferguson 26.10.61. 92 Sqn (B) 1.4.63. Damaged after sinking onto runway during take-off 9.1.68, transported to Warton by Belfast 3.4.68, converted to F.2A standard. On loan to MoT at A&AEE 24.6.69. To 92 Sqn (F later V) 23.7.69. SOC 1.4.77. To Coningsby 4.4.77 last flight with 3008 hours. Allocated 8546M to battle damage/rescue training. Sold to A1 Commercials 19.10.83. Transported to site and placed on display. Subsequently abandoned, wreckage still visible.

XN729
C/N 95106 ff T.M.S. Ferguson 3.11.61. AFDS (L) 1.3.63. To A Sqn A&AEE 14.8.64 for in-flight refuelling trials. Returned to Warton for modifications then back to A&AEE for tropical trials. Sold to BAC and returned to Warton 25.1.67 for conversion to F.52 standard for RSAF allocated G-27-1. To Wattisham 8.5.67 then to Riyadh via Cyprus as 52-659. To 6 Sqn (612) replacing 52-657 (XN796) which crashed 20.9.66. To Khamis Mushayt 8.67- Crashed at Khamis Mushayt 2.5.70 with 547 hours following indicated hydraulic failure. Pilot ejected safely.

XN730
C/N 95107 ff D. de Villiers 23.11.61. 19 Sqn (B) 12.3.63. To Saudi Arabia 4.7.64 displayed by J.Dell as part of sales project. To Warton 4.10.67 for conversion to F.2A standard. To 92 Sqn (J) 30.8.68. Damaged 11.3.76, SOC 28.2.77 with 2704 hours. Airfield decoy at Gutersloh allocated 8496M. To Deutsches Luftwaffen Museum Uetersen 1982. To Gatow by Chinook 1995.

XN731
C/N 95108 ff T.M.S. Ferguson 8.1.62. Handling Sqn A&AEE 22.4.63. 92 Sqn (M) 30.5.63. To Warton 21.3.69 for conversion to F.2A standard. 92 Sqn (L) 31.12.69. To Leconfield then Warton 12.11.70. 19 Sqn (Z) 11.12.70. WFU with 2845 hours 12.76. Airfield decoy at Laarbruch allocated 8518M (D2). Sold as scrap to Solair UK 7.3.85.

XN732
C/N 95109 ff J.K. Isherwood 19.1.62. 92 Sqn (H) 30.4.63. Warton 25.11.68 for conversion to F.2A standard. To 92 Sqn ® 12.8.69. WFU 12.76 with 3049 hours. Airfield decoy at Laarbruch 2.77 allocated 8519M (D6). To crash/rescue training. Subsequently reconfigured as pseudo-MiG aircraft on airfield (coded 17) and subsequently scrapped on site.

XN733
C/N 95110 ff D. de Villiers 1.2.62. 92 Sqn (L) 6.6.63. Damaged by starter explosion, transported to Warton by road 4.12.68 for conversion to F.2A standard. To 19 Sqn (coded R) 31.12.69. On loan to BAC for SBAC Farnborough show 1970 as a representative F.53 aircraft. To Warton then 60 MU 16.9.70. 92 Sqn (U) 25.9.70. 19 Sqn (Y) 3.12.70. WFU 12.76 with 2764 hours. Airfield decoy at Laarbruch allocated 8520M (D1). Sold as scrap 25.2.85 to Solair UK.

XN734
C/N 95113 ff D. de Villiers 13.7.62. Retained by EE for development work, fitted with Avon 301 engines and Stage 3 tail fin. To MoA on loan at A&AEE 16.5.63 for reheat handling trials. To Warton 31.12.63 for development work. Overwing tank flight trials. To Rolls Royce Hucknall 6.12.65. To Warton 18.9.67 for trials, fitted with large ventral tank. To A Sqn A&AEE 31.10.69. To 60 MU for storage 5.2.70 allocated 8364M. Sold to BAC as G-27-239. Flown to Warton 26.6.63, last flight with 194 hours. To Saudi Support Unit. Bought by Aces High as G-BNCA and transported to Cranfield 28.10.87. Sold to Nev Martin and scrapped 1.12.94.

XN735
C/N 95114 ff D. de Villiers 23.2.62. 92 Sqn (J) 10.5.63. To Warton 30.8.68 for conversion to F.2A standard. To 19 Sqn (A) 25.4.69. To 92 Sqn (U) 7.12.76. To Wildenrath 6.4.77, last flight with 3244 hours. Airfield decoy allocated 8552M. Sold as scrap to Salvair International 10.7.86 and removed by 87.

XN767
C/N 95115 ff T.M.S. Ferguson 19.2.62. To 33 MU Lyneham for storage 8.7.63. Sold to BAC 4.66 and flown to Warton 9.5.66 for conversion to F.52 standard for RSAF allocated 52-655. To Saudi Arabia via Wattisham and Akrotiri, arriving 28.7.66. To 6 Sqn (609) Riyadh. To Khamis Mushayt 8.67. Last flight 6.72 with 178 hours. On display at Dhahran.

XN768 C/N 95121 ff T.M.S. Ferguson 14.3.62. 33MU Lyneham for storage 5.7.63. To 92 Sqn (S) 5.5.64. To 60 MU 2.66, 6.68 and 11.70. Remained with 92 Sqn until last flight on 3.73 with 1392 hours. Airfield decoy at Gutersloh allocated 8347M. Scrapped 6.78.

XN769
C/N 95122 ff D. de Villiers 31.3.62. 33 MU Lyneham for storage 5.9.63. To 92 Sqn (F) 5.8.65. To 19 Sqn (X) 28.9.66. To 92 Sqn (Z) 11.1.67. To 60 MU for storage 23.12.71 on final flight with 950.20 hours. Transported to Leconfield for display 28.6.74 allocated 8402M. To West Drayton 8.76 for display. Sold to Hanningfield Metals as scrap 16.1.94. Nose section preserved by Ron Carpenter, New Eltham.

XN770
C/N 95123 ff T.M.S. Ferguson 24.4.62. To 33 MU Lyneham for storage 5.9.63. Sold to BAC and flown to Warton 4.5.66 for conversion to F.52 standard for RSAF as 52-656. Delivered to Riyadh via Akrotiri and Muharraq arriving 7.66. To 6 Sqn (610). To Khamis Mushayt 8.67. Final flight 6.72 with 257 hours. Abandoned on airfield but subsequently preserved by 99 as part of RSAF Museum.

XN771
C/N 95124 ff R.P. Beamont 29.8.62. To CFE Binbrook 14.11.62 and AFDS (M). To 33 MU Lyneham for storage 30.1.64. To Warton 21.9.66 for conversion to F.2A standard. To 19 Sqn (P) 25.3.69. To 92 Sqn (S) 1.77. To RAE Farnborough 4.4.77 with 2238 hours on final flight. Allocated 8547M. To P&EE Foulness Island 24.4.78. Scrapped 1995.

XN772
C/N 95125 ff D. de Villiers 10.5.62. On loan to MoA, to A Sqn A&AEE 1.11.63. To Warton 10.3.65. To A&AEE then Rolls Royce Hucknall 28.7.66 for Avon 211 trials. To A&AEE 23.5.67 then Warton 4.9.67 for conversion to F.2A standard. To 92 Sqn (N) 2.8.68. Crashed 28.1.71 with 971 hours near Diepholz after entering a spin. Pilot P. Hitchcock ejected safely.

XN773
C/N 95126 ff D. de Villiers 13.6.62. On loan to MoA. To Rolls Royce Hucknall 25.5.64. To 60 MU Leconfield 30.9.65 for storage. To Warton 10.7.67 for conversion to F.2A standard. To 92 Sqn (E) 26.6.68. Final flight 12.76 with 2494 hours. Airfield decoy at Laarbruch allocated 8521M (D3). Sold to Solair UK and scrapped on site 5.3.85.

XN774
C/N 95127 ff D. de Villiers 27.9.62. 19 Sqn (coded C) 13.2.63. To Warton 13.8.69 for conversion to F.2A standard. To 92 Sqn (F) 2.9.70. Mid-air collision with XN727 16.9.71 resumed flying 18.8.72. To Coningsby 4.4.77 with 2927 hours. Airfield decoy allocated 8551M. Broken up during exercise. Nose preserved by Darren Swinn, Boston. Remains scrapped on site by 1998.

XN775
C/N 95128 ff T.M.S. Ferguson 1.10.62. 19 Sqn (D) 17.12.62. To Warton 7.6.68 for conversion to F.2A standard. To 92 Sqn (B) 15.1.69. Final flight 5.75 with 2876 hours. Airfield decoy at Gutersloh allocated 8448M. Scrapped 1984.

XN776
C/N 95129 ff D. de Villiers 18.10.62. 19 Sqn (E) 13.2.63. To Warton 14.1.69 for conversion to F.2A standard. To 19 Sqn (coded C) 13.8.69. To 92 Sqn (coded C) 1.77. To Leuchars 1.4.77, last flight with 3285 hours. Airfield decoy allocated 8535M. To Museum of Flight, East Fortune 8.5.82.

XN777
C/N 95130 ff D. de Villiers 13.7.62. AFDS 6.12.62. Re-issued to AFDS (N) after post-damage repairs. To 33 MU Lyneham for storage 30.1.64. To Warton 5.10.66 for conversion to F.2A standard. To 19 Sqn (K) 26.3.68. Final flight 6.4.77 with 2496 hours, to Wildenrath. Airfield decoy allocated 8536M. Sold to Salvair and scrapped on site 1986.

XN778
C/N 95131 ff T.M.S. Ferguson 9.11.62. 19 Sqn (F) 9.1.63. To Warton 10.5.68 for conversion to F.2A standard. To 19 Sqn (H) 19.12.68. To 92 Sqn (A) 30.4.74. Final flight 5.4.77 with 3119 hours to Wildenrath. Airfield decoy allocated 8537M. Sold as scrap 17.4.91 and broken up on site.

XN779
C/N 95132 ff R.P. Beamont 20.11.62. 19 Sqn (G) 27.2.63. To Warton for fuel system repairs 11.3.66. To 60 MU for servicing then 19 Sqn (X) 8.7.71. SOC 3.5.73 with 1190 hours. Spares source allocated 8348M. To dump 9.73. Nose section removed 1977 (location unknown), remainder of airframe broken up on site 1977.

XN780
C/N 95133 ff D. de Villiers 7.12.62. 19 Sqn (H) 12.2.63. To Warton 27.2.67 for conversion to F.2A standard. To 92 Sqn (K) 4.10.68. To 60 MU for servicing then 92 Sqn (J later K) 11.9.72. SOC following fire on ground 29.9.75 with 2981 hours. Airfield decoy allocated 8663M. Scrapped on site 1984.

XN781
C/N 95134 ff T.M.S. Ferguson 12.12.62. 19 Sqn (J) 15.3.63. To 33 MU Lyneham for storage 27.1.65. To Warton 13.9.66 for conversion to F.2A standard. To 19 Sqn (B) 26.2.68. SOC 1.4.77 and flown to Leuchars 5.4.77 on final flight with 2750 hours. Airfield decoy allocated 8538M. Dismantled and transported to Withington and subsequently scrapped 1990.

XN782
C/N 95135 ff R.P. Beamont 20.12.62. 19 Sqn (K) 19.2.63. To Warton 27.3.68 for conversion to F.2A standard. To 92 Sqn (H) 25.11.68. Final flight 5.4.77 to Wildenrath with 2977 hours. Airfield decoy allocated 8539M. To Luftfahrtausstellung Museum at Hermeskiel 27.6.86.

XN783
C/N 95136 ff D. de Villiers 26.1.63. 92 Sqn (A) 26.3.63. To Warton 1.5.69 for conversion to F.2A standard. To 19 Sqn (G) 11.5.70. Final flight 11.1.77 with 2983 hours, to Bruggen. Airfield decoy allocated 8526M. Scrapped on site 1992.

XN784
C/N 95137 ff J.K. Isherwood 26.1.63. 19 Sqn (L) 19.3.63. To Warton 30.1.69 for conversion to F.2A standard. To 19 Sqn (G) 26.9.69. To Warton for modifications then to 19 Sqn (coded R) 18.6.70. Final flight to Bruggen 31.3.77 with 3214 hours. Airfield decoy allocated 8540M. To Mönchengladbach Airport by Chinook 19.7.85, fuselage markings changed to XN781. On display under ownership of airport authorities, donated by Joint Services Liaison Officer.

XN785
C/N 95138 ff J.K. Isherwood 30.1.63. 92 Sqn (coded C) 5.4.63. Crashed 27.4.64 at Hutton Cranswick (disused airfield) following double engine flame-out. Pilot G. Davie initiated ejection sequence too late and was killed. Total of 282 hours. Wreckage recovered to Dishforth.

XN786
C/N 95139 ff T.M.S. Ferguson 12.2.63. 92 Sqn (D) 9.4.63. To 60 MU for modifications following landing accident then to Warton 29.10.68 for conversion to F.2A standard. To 19 Sqn (M) 1.7.69. On loan to 92 Sqn 8.10.71. First Lightning to receive camouflage paint 9.72. Ground fire 4.8.76, grounded with 2659 hours. Airfield decoy allocated 8500M. Scrapped on site 1982.

XN787
C/N 95140 ff T.M.S. Ferguson 15.2.63. 19 Sqn (M) 22.3.63. To Warton 1.7.69 for conversion to F.2A standard. To 92 Sqn (L) 4.3.71. SOC 1.1.77. Total of 3218 hours. Airfield decoy at Laarbruch allocated 8522M (D5). Dismantled 3.85 and transported to Mönchengladbach. Sold as scrap by Disposals Organisation.

XN788
C/N 95141 ff R.P. Beamont 25.2.63. To Modification Centre Leconfield 23.5.63 then 92 Sqn (coded R). To Warton 12.8.69 for conversion to F.2A standard. To 92 Sqn (P) 17.8.73. To Bruggen on last flight 31.3.77 with 2661 hours. Airfield decoy allocated 8543M.
To Laarbruch by Chinook 7.2.87. Battle damage repair duties. Sold as scrap and dismantled on site 4.91.

XN789
C/N 95142 ff D. de Villiers 11.3.63. 92 Sqn (G) 26.4.63. To 33 MU Lyneham for storage 8.1.64. To Warton 5.9.66 for conversion to F.2A standard. To Handling Sqn A&AEE 3.1.68. To 19 Sqn (J) 15.1.68 – first F.2A for 19 Sqn. SOC 1.1.77 with 2671 hours. To Bruggen 11.1.77. Airfield decoy allocated 8527M. Sold as scrap 4.91 and dismantled on site.

XN790
C/N 95143 ff J.K. Isherwood 20.3.63. 92 Sqn (E) 25.4.63. To Warton 26.6.68 for conversion to F.2A standard. To 19 Sqn (L) 30.1.69. Completed 3,000th hour 4.8.75. SOC 1.1.77 with 3397 hours. Airfield decoy at Laarbruch 2.77 allocated 8523M (D4). Sold as scrap to Solair and dismantled on site 7.3.85.

XN791
C/N 95144 ff R.P. Beamont 4.4.63. 19 Sqn (P) 15.5.63. Initial delivery 9.5.63 but returned to Warton with engine fire warning. To Warton 21.3.68 for conversion to F.2A standard. To 92 Sqn (D) 29.10.68. To Bruggen on final flight 12.1.77 with 3301 hours. 431 MU Battle Damage repair training allocated 8524M. To dump 1982. Scrapped and removed 9.2.84.

XN792
C/N 95145 ff R.P. Beamont 19.4.63. 92 Sqn (N) 23.6.63. To Warton 2.8.68 for conversion to F.2A standard. To 92 Sqn (M) 21.3.69. To Bruggen on final flight 12.1.77 with 3085 hours. 431 MU Battle damage repair training, allocated 8525M. To dump 1982, subsequently scrapped on site.

XN793
C/N 95146 ff D. de Villiers 1.5.63. 92 Sqn (K) 21.6.63. To Warton 26.9.68 for conversion to F.2A standard. To 92 Sqn (A) 1.5.69. To 19 Sqn (H) 30.4.74. To 92 Sqn (X) 7.12.76. To Wildenrath on final flight 6.4.77 with 3052 hours. Airfield decoy allocated 8544M. Repainted for exercise. Sold as scrap to Salvair 7.86, removed 1987.

XN794
CN 95147 ff T.M.S. Ferguson 16.5.63. 33 MU Lyneham for storage. To 92 Sqn (P) 11.10.65. To 19 Sqn (W) 5.67. Final flight 22.5.74 with 1295 hours. Last flight of Lightning F.2. Airfield decoy at Gutersloh allocated 8349M. Dismantled 11.77 nose section to Laarbruch. Nose and remainder of airframe subsequently removed as scrap by 1984.

XN795
C/N 95148 ff J. Carrodus 30.5.63. 33 MU Lyneham for storage 12.7.63. On loan To MoA 7.7.64. To Warton 9.7.64 for conversion to F.2A standard. Held in storage at Warton. Sold to MoT. To A Sqn A&AEE 12.11.68 for continuation training. To Warton 19.4.72. Mauser 27mm cannon trials for Tornado programme. Chase aircraft for Tornado programme. To RAE Bedford 3.77 with 445 hours. To P&EE Foulness Island 5.4.79. Nose section recovered by Nigel Towler1993. Remainder of airframe scrapped on site 2.96.

XN796
C/N 95149 ff D. de Villiers 12.7.63. 33 MU Lyneham for storage 11.10.63. Sold to BAC, to Warton 29.4.66. Converted to F.52 standard allocated 52-657. Delivery to RSAF via Wattisham and Akrotiri arriving Riyadh 15.7.66. Crashed on take-off 20.9.66 with 34 hours. Pilot Peter Hay ejected safely though injured. Subsequently scrapped on site.

XN797
C/N 95150 ff T.M.S. Ferguson 5.9.63. 33 MU Lyneham for storage 4.10.63. Sold to BAC, to Warton 28.4.66 for conversion to F.52 standard, allocated 52-658. Delivered to Riyadh via Wattisham and Akrotiri, arriving 28.7.66. To 6 Sqn (611). Crashed due to fuel asymmetry 28.1168 at Khamis Mushayt with 126 hours. Pilot Major Hymlas killed.

F.Mk.3

XP693
C/N 95116 ff J.L. Dell 16.6.62. Withdrawn from F3 production and converted to F.6 standard. To A Sqn A&AEE 24.5.63 for CA Release trials. To Warton 4.10.63. Successive spells at Boscombe Down, returning to Warton. Trials included arrestor hook, ventral tank fit, and ventral gun pack including ground firing and first aerial firing on 31.12.68. To MRCA avionics programme 1972. To RAE Bedford 22.7.75. To RAE Farnborough 9.76. To Warton 28.1.77. Tornado programme chase aircraft. Target and chase aircraft for Tornado F.2 programme. Final trials flight 12.11.92 with 1161.33 hours. Sold to Barry Pover and flown to Exeter 23.12.92 as G-FSIX. Sold to Mike Beachyhead and shipped to South Africa as ZU-BEY. Currently airworthy with Thunder City.

XP694
C/N 95117 ff R.P. Beamont 1.5.63. Retained at Warton on development work. To A Sqn A&AEE 1.8.63 for CA Release trials. On loan To MoA, operated by Ferranti on radar development. To 60 MU reconciled 26.1.67 for storage. To 29 Sqn (D) 18.5.67. On loan to 111 Sqn 8.9.70. Storage Flight Wattisham 1.1.75. To 56 Sqn (V) 3.3.75. To LTF 10.76 (coded A by 1.77). Repaint 22.2.78, last aircraft to receive grey/green camouflage. To 5 Sqn (coded R) 20.3.78. To 11 Sqn 7.5.82 initially with LAF markings later coded (BO). Storage at Binbrook 1.6.84 with 2522.20 hours. Partially dismantled and transported to Otterburn 16.4.88. Scrapped 1999.

XP695
C/N 95119 ff R.P. Beamont 20.6.63. CFE Binbrook 1.1.64. AFDS (coded R). FCTU 31.1.66. To 60 MU Leconfield for storage 4.7.66. To Warton for modification to full F.3 standard 3.7.67. To Wattisham 9.12.68 for ferrying to Cyprus. To 56 Sqn (N) 3.1.69. To 29 Sqn (L) 14.10.71. To 111 Sqn (L) 8.72. To 60 MU for servicing then 11 Sqn (O) 11.6.74. On loan to 5 Sqn 10/11.75 for Harrier VIff trials. To ASSF then 11 Sqn (N) 30.11.77. Last flight 15.9.80. To storage with 2600 hours. Allocated 8808M to BDRT. Sold to R. Austin as scrap, dismantled and removed 25.9.87.

XP696
C/N 95120 ff J.L. Dell 2.7.63. CFE Binbrook 15.1.64. To Boscombe Down for Red Top trials 16.2.66 to 5.6.67 To Warton for full F.3 modifications. To 226 OCU (696) 18.6.70. Solo display aircraft with white painted spine and tail 1974. On loan to 111 Sqn and 29 Sqn 1974. Storage Wattisham 8.10.74. 1186 hours. To dump 4.75. Sold as scrap 10.75.

XP697
C/N 95151 ff D.M. Knight 18.7.63. Ferried to Filton same day for conversion to F.6 standard. Trials aircraft for Extended Range F.3 programme. Displayed SBAC Farnborough show 1964. To A&AEE 2.11.64 for handling trials with cambered leading edge. Displayed at SBAC Farnborough show 1966. Spin trials at Binbrook 12.69. Combat manoeuvre trials at Binbrook 7.70. MRCA programme 7.72. To Binbrook for storage 12.12.75. Received grey/green camouflage, selected for fatigue analysis. Brought up to flight standard and ferried to Warton 3.10.78 on last flight with 300 hours. Dismantled at Warton 1983.

XP698
C/N 95152 ff T.M.S. Ferguson 28.8.63. Trials aircraft for ER F.3 programme. Damaged in ground run trials and replaced by XP697. To A Sqn A&AEE 19.12.63 and 5.3.64. To 74 Sqn (F) 3.6.64. To 56 Sqn (T) 18.1.67. To 29 Sqn (B) 10.5.67. Crashed in North Sea following collision with XP747, 40 miles E of Ipswich 16.2.72 with 1378 hours. Pilot Paul Reynolds ejected safely.

XP699
C/N 95153 ff D. de Villiers 2.9.63. MoA loan. To A&AEE 10.4.64. To Wheelus AFB Libya for tropical trials 12.7.64. To 33 MU Lyneham 30.11.64. To 56 Sqn (O) 13.2.67. Crashed 3.3.67 near Finchingfield, East Anglia following fuel leak fire. 299.30 hours. Pilot Stuart Pearse ejected safely. Wreckage to Debden then to Farnborough.

XP700
C/N 95154 ff D. de Villiers 6.6.63. 74 Sqn (coded A) 14.4.64. Wattisham Mod Centre 20.10.66. To 56 Sqn (P) 22.11.66. To 111 Sqn (Z) 13.3.67. To 29 Sqn (K) 16.2.68. Crashed 7.8.72 at Newton, Suffolk, following rupture of ventral tank after aircraft settled onto runway during take-off. Pilot George Fenton ejected safely. 1653.15 hours.

XP701
C/N 95155 ff T.M.S. Ferguson 14.9.63. On loan to MoA. A Sqn A&AEE 1.7.64. To 29 Sqn (M) 8.9.67. To 111 Sqn (M) 2.11.70. To 29 Sqn (F) 22.2.72. To 60 MU then 29 Sqn (F). To storage Flight Wattisham 1.1.75 then 56 Sqn (W) 21.3.75. To ASSF Binbrook 17.7.76. To 11 Sqn (O) 7.3.78. Various periods with 5 and 11 Sqns then 11 Sqn (BN). To 5 Sqn (AN) 10.5.84. WFU 22.1.87 allocated 8924M with 2977.10 hours. To Kent BofB Museum Hawkinge by CH-53 via Sculthorpe 18.12.87. Scrapped 8.9.90, nose section to Richard Hukins, to Robertsbridge Aviation Society 12.91.

XP702
C/N 95156 ff D. de Villiers 19.9.63. 74 Sqn (coded C) 14.5.64. To 56 Sqn (coded R) 18.11.66. To 111 Sqn 4.6.68 then 29 Sqn for proving flights prior to ferry flight to Cyprus. To 56 Sqn (coded R) 18.9.68. To 60 MU reconciled 18.8.72. To 29 Sqn (coded C) 17.10.73. Storage Flight Wattisham 1.1.75. To 56 Sqn (U) 3.3.75. To LTF (deployed to Coningsby) 1.7.76. ASSF Binbrook (U) 4.10.76. To 5 Sqn (P) 1.6.79. To 11 Sqn (N later BN and BO) 20.8.79. To ASSF storage 16.6.82. LAF markings. Retained in storage with 2680.10 hours. External storage 11.87. Transported to Otterburn 16.4.88. Removed as scrap 1999.

XP703
C/N 95157 ff D. de Villiers 28.9.63. 74 Sqn (G) 8.6.64. Wattisham Mod Centre 10.66. To 56 Sqn (S) 22.11.66. To 60 MU then briefly 56 and 111 Sqns, then 29 Sqn for proving flights prior to being ferried to Cyprus. To 56 Sqn (S) 18.9.68. To 60 MU Leconfield 14.9.71. To 29 Sqn (G) 11.8.72. Storage Flight Wattisham 1.1.75. To 60 MU then Warton 23.5.75 for structural tests with 2167 hours. External storage 11.75. Dismantled 6.76. Nose section to LPG Bruntingthorpe 23.8.89.

XP704
C/N 95158 ff R.P. Beamont 17.10.63. 74 Sqn (H) 15.6.64. Crashed at Leuchars 28.8.64 during aerobatic sequence with 36.40 hours. Entered spin during loop manoeuvre. Pilot Glyn Owen ejected late and was killed. Wreckage removed as scrap.

XP705
C/N 95159 ff D. de Villiers 12.10.63. 74 Sqn K 26.6.64. Wattisham Mod Centre 8.12.66. To 56 Sqn (W) 6.2.67. To 23 Sqn (K) 28.2.67. Displayed at Paris show 1967. 29 Sqn (B) 1.5.68. To Warton 15.7.70. To 29 Sqn (L) 14.1.71. Crashed at sea off Akrotiri 8.7.71 following reheat fire. Pilot Graham Clarke ejected safely. 1520 hours. Wreckage not recovered.

XP706
C/N 95160 ff T.M.S. Ferguson 28.10.63. 74 Sqn (L) 13.7.64. To 111 Sqn (D) 21.12.66. To 60 MU then 111 Sqn (F) 30.1.70. To ASSF Binbrook 3.11.75. To LTF 17.11.75. To 5 Sqn (coded R later AR) 31.10.79. ASSF then 11 Sqn (BM) 24.9.82. To LTF (DD) 22.6.83. WFU 22.1.87. Allocated 8925M with 3145.45 hours. Stored on airfield. Sold to Lincolnshire Lightning Preservation Society, towed by tractor to Strubby 20.12.87. To Hemswell 30.1.99. To Aeroventure Doncaster 11.02.

XP707
C/N 95161 ff R.P. Beamont 13.11.63. 23 Sqn (coded A) 19.8.64. To 29 Sqn (H later F) 24.7.67. To 60 MU then 226 OCU (707) 10.12.71. To Filton for storage 9.9.74. To Wattisham Storage Flight 18.12.74. To 5 Sqn (P) 27.6.76. To 11 Sqn (BM) 24.9.80. To 11 Sqn (BO) 22.1.86. To LTF (DB) 11.3.86. Crashed 19.3.87 during aerobatic display routine at Binbrook. Fuel problem led to failure of CofG limit causing spin. Pilot Barry Lennon ejected safely. Wreckage recovered, components to BofB Museum Hawkinge, remainder scrapped. 2392.45 hours.

XP708
C/N 95162 ff R.P. Beamont 20.11.63. 23 Sqn (B) 19.8.64. Wattisham Mod Centre then 29 Sqn (F) 26.6.67. 60 MU Leconfield then 29 Sqn (N) 2.10.68. To 60 MU following recurrent fuel leaks 4.2.75. 2217 hours. Spares recovery, remainder to dump 1.76. To P&EE Foulness Island 8.6.76. To Pendine 15.6.84. Dismantled 6.89, scrapped 1997.

XP735
C/N 95163 ff R.P. Beamont 4.12.63. 23 Sqn (E) 17.9.64. Wattisham Mod centre then 29 Sqn (L) 1.9.67. Overshot into barrier due brake failure 13.5.74. To 60 MU following recurrent repairs 9.1.75 with 2027 hours. Nose section removed 10.75. Remainder sold as scrap to J. Shackleton 22.12.75.

XP736
C/N 95164 ff D. de Villiers 13.12.63. 23 Sqn (F) 17.9.64. Wattisham Mod Centre then 60 MU 22.9.67. To 29 Sqn (G) 2.4.68. Crashed 22.9.71 in North Sea 30 miles East of Lowestoft following loss of control. Pilot Phil Mottershead not found. 1543 hours.

XP737
C/N 95165 ff R.P. Beamont 1.1.64. 23 Sqn (L) 21.10.64. Wattisham Mod centre then returned to 23 Sqn then 29 Sqn (J) 10.8.67. To 60 MU 5.11.69. To 226 OCU (737) 3.7.70. Displayed at SBAC Farnborough show 1970. To Filton for storage 9.9.74. Wattisham Storage Flight 18.12.74. To ASSF Binbrook then 11 Sqn (P later N) 18.5.76. Crashed Irish Sea during attempt to land at valley 17.8.79. Port main undercarriage failed to lower. Pilot Ray Knowles abandoned aircraft and ejected safely. 2042 hours.

XP738
C/N 95166 ff R.P. Beamont 18.1.64. 33 MU Lyneham 4.11.64. To 111 Sqn (G) 15.1.65. To Wattisham Mod centre then 60 MU then returned to 111 Sqn (E) 3.4.69. SOC 7.1.74 following wheel-up landing at Wattisham. 2072 hours. On dump 6.74 and subsequently scrapped, parts to Warton for fatigue tests.

XP739
C/N 95167 ff T.M.S. Ferguson 20.1.64. 33 MU Lyneham. To 111 Sqn (H) 15.1.65. Crashed 29.9.65 near Stowmarket, Suffolk on approach to Wattisham following double engine flame out. Pilot Hedley Molland ejected safely. 176.45 hours, wreckage recovered to Wattisham.

XP740
C/N 95168 ff D. de Villiers 1.2.64. 111 Sqn (J) 30.12.64. To Wattisham Mod centre 13.2.67. To 60 MU 22.7.70. To 111 Sqn (B) 10.3.71. Wattisham Storage Flight 1.10.74. SOC 28.11.74 with 2180 hours. To dump 4.75, subsequently scrapped.

XP741
C/N 95169 ff R.P. Beamont 4.2.64. 111 Sqn (K) 22.12.64. 60 MU Leconfield 30.7.70. To 111 Sqn (D) 20.5.71. To 5 Sqn (X) 22.10.74. To 11 Sqn (N later O and BO) 3.2.75. To LTF (DD) 13.4.81. To 5 Sqn then LTF (DA) 30.1.87. To 5 Sqn (AR) 1.5.87 (air display aircraft). Allocated 8939M to Manston 30.9.87 with 3164.55 hours. GIA subsequently fire training, destroyed 1995.

XP742
C/N 95170 ff D.M. Knight 12.2.64. Iii Sqn (L) 10.2.65. To Wattisham Mod centre then 60 MU 17.1.68. To 111 Sqn (G) 30.7.68. Crashed into North Sea off Happisburgh, Norfolk, 7.5.70 following engine failure and fire. Pilot Stu Tulloch ejected safely. 1258 hours.

XP743
C/N 95171 ff D. de Villiers 18-2.64. 33 MU Lyneham 18.2.65. To 56 Sqn (G) 18.3.65. To Wattisham Mod centre then 60 MU 14.1.69. To Coltishall 29.9.69 then loan to 29 Sqn prior to ferrying to Cyprus. 56 Sqn (K) 11.69. To 60 MU reconciled for storage 9.11.71. To 29 Sqn (B) 18.8.72. To 60 MU 9.1.75. To dump 9.75 with 2048 hours. Sold to J. Shackleton as scrap 15.12.75.

XP744
C/N 95172 ff R.P. Beamont 25.2.64. 33 MU Lyneham 9.3.65. To 56 Sqn (H) 22.4.65. To 60 MU Leconfield 28.3.68. To 111 Sqn for preparation prior to ferry flight to Cyprus 11.68. To 56 Sqn (H) 3.1.69. Crashed into sea 8 miles off Akrotiri 10.5.71 following reheat fire. Pilot R.D. Cole ejected safely. 1304.45 hours.

XP745
C/N 95173 ff D. de Villiers 18.3.64. 56 Sqn (J) 20.5.65. To 60 MU Leconfield 16.7.69. To 29 Sqn (H) 20.4.70. Wattisham Storage Flight 1.1.75. To 60 MU 4.2.75. 1886.45 hours. To dump 2.76. To Boulmer as gate guard allocated 8453M 14.12.76. Sold to Vanguard Engineering 4.93 and dismantled. Nose retained for exhibition.

XP746
C/N 95174 ff D. de Villiers 26.3.64. 56 Sqn 15.4.65. Withdrawn for repairs, returned to 56 Sqn (K) 2.6.65. To 60 MU then 111 Sqn (J) 5.8.70. Wattisham Storage Flight 1.10.74. SOC 28.11.74 with 2170 hours. Stored on airfield and scrapped 1975.

XP747
C/N 95175 ff T.M.S. Ferguson 8.5.64. 56 Sqn (L) 25.6.65. To Wattisham Mod centre following landing accident. To 60 MU then 29 Sqn (S) 23.7.70. Crashed into North Sea 40 miles East of Ipswich 16.2.72 after collision with XP698. 1336 hours. Pilot Paul Cooper was killed.

XP748
C/N 95176 ff T.M.S. Ferguson 4.5.64. 56 Sqn (M) 4.8.65. 111 Sqn (G) 6.5.70. To 11 Sqn Binbrook (P). To ASSF 12.74. WFO following accident 28.4.75 with 2252 hours. Allocated 8446M, placed in open storage. To gate guard on plinth 29.5.77. To RAE 12.5.88. To Pendine 29.6.88. Sold as scrap and removed 1997.

XP749
C/N 95177 ff D.M. Knight 11.12.63. CFE and AFDS (T) 8.4.64. To 111 Sqn (B) 21.12.65. To Wattisham Mod centre and 60 MU then 111 Sqn (K) 26.10.70. Storage Flight Wattisham 1.10.74. To Binbrook ASSF 26.3.76. To 5 Sqn 19.1.77. To LTF (later A) 28.6.77. On loan to 11 Sqn 25.8.81 then LTF (DB) 12.81. To 11 Sqn (BK1 later BK2) 6.4.84 – air display aircraft. LAF markings then (BO). To LTF (DB later DA) 15.11.85. WFU 22.1.87 with 3212.05 hours. Allocated 8926M open storage. Sold to W.H. Whatnell as scrap, removed 1.88.

XP750
C/N 95178 ff R.P. Beamont 3.1.64. To CFE and AFDS (U) 26.3.64. To 111 Sqn (H) 28.12.65. To 226 OCU (750) 9.71. To 111 Sqn (H) 21.12.73. To 23 Sqn (P) 15.5.74. To ASSF Binbrook 8.9.75 and LTF (B) 4.4.76. To 5 Sqn (Q later AQ) 13.2.80. To LTF (DE) 8.12.83. WFU 22.1.87 with 3456 hours. Allocated 8927M in storage then external storage. Sold to W. Whatnell as scrap, removed 1.88.

XP751
C/N 95179 ff T.M.S. Ferguson 16.3.64. First full-standard F.3 delivered. 74 Sqn (B) 29.4.64. To 23 Sqn (K) 18.11.66. To 60 MU then 111 Sqn (L) 5.12.67. To 23 Sqn (Q) 15.5.74. To ASSF Binbrook then LTF 4.11.75. To 5 Sqn 10.11.75, on load for VIff trials at Brawdy then to LTF (eventually coded C) 6.1.76. To 5 Sqn (S later AQ) 21.8.78. To LTF (DB later DA) 3.9.84. Final flight 22.10.86 with 3101.05 hours. Storage then allocated 8928M for external storage. Sold as scrap and removed 1.88.

XP752
C/N 95180 ff T.M.S. Ferguson 20.4.64. 74 Sqn (D) 1.6.64. Wattisham Mod centre then 23 Sqn (O) 2.1.67. 111 Sqn (Y) 10.11.67. To 111 Sqn (D) detached to Binbrook 25.7.69. On loan to MoT A&AEE 2.2.70. Allocated 8166M at Coltishall following collision 20.5.71 with AdIA Mirage over Colmar. 1363 hours. Rear fuselage to ASF, remainder to Coltishall dump, destroyed 1982.

XP753
C/N 95181 ff T.M.S. Ferguson 8.5.64. 74 Sqn (J) 23.6.64. To 111 Sqn (Y) 22.2.67. To Cyprus then 56 Sqn (coded C later J) 26.3.68. To 60 MU for storage 9.11.71. To 11 Sqn (I later L) 14.11.73. To 5 Sqn (X) 1.3.74. To LTF (later DC) 10.6.81. 1983 aerobatic display aircraft. Crashed 26.8.83 off Scarborough during unauthorised display. Pilot Mike Thompson ejected but was killed. Aircraft wreckage recovered to Binbrook via Grimsby.

XP754
C/N 95182 ff D. de Villiers 5.6.64. 74 Sqn (M) 31.7.64. Wattisham Mod Centre then 56 Sqn (X) 6.2.67. To 111 Sqn (X later A) 9.2.67. To 60 MU then 111 Sqn (H later R) 27.2.69. To 29 Sqn (E) 1.10.74. Wattisham Storage Flight 2.10.74. SOC 28.11.74 with 2294 hours. Scrapped on site 19.4.75, components to Warton for fatigue tests.

XP755
C/N 95183 ff D. de Villiers 15.6.64. 74 Sqn (P) 31.7.64. Wattisham Mod Centre then 56 Sqn (U) 27.2.67. To 60 MU then 111 Sqn prior to ferry flight to Cyprus. 56 Sqn (U) 3.1.69. To 60 MU for storage 6.3.70. To 29 Sqn (E) 29.6.72. To 60 MU 15.1.75. External storage, SOC 16.10.75 with 1959 hours. Sold as scrap to J. Shackleton, removed 12.75.

XP756
C/N 95184 ff R.P. Beamont 22.6.64. 23 Sqn (coded C) 24.8.64. To 29 Sqn (K) 10.8.67. Crashed into North Sea of Yarmouth 25.1.71 following reheat fire. Pilot Bill Povilus (USAF) ejected safely. 1130 hours, wreckage not recovered.

XP757
C/N 95185 ff T.M.S. Ferguson 4.7.64. 23 Sqn (G) 25.9.64. To 60 MU 20.9.67. On loan to MoT A Sqn A&AEE 13.12.67. To 29 Sqn (F) 15.2.68. To 60 MU 19.6.70. To 29 Sqn (M) 17.3.71. To 60 MU 9.1.75. SOC 13.11.75 with 2083 hours. Sold to J. Shackleton as scrap, removed 12.75. Components to Darren Swinn, Boston.

XP758
C/N 95186 ff D. de Villiers 10.7.64. 23 Sqn (D) 14.9.64. Wattisham Mod centre then 60 MU. To 111 Sqn (S) 3.5.68. To 29 Sqn (S) 22.5.74. To 60 MU 15.1.75. SOC 13.11.75, sold to J. Shackleton as scrap, removed 12.75. 2054 hours.

XP759
C/N 95187 ff D. de Villiers 14.8.64. 23 Sqn (J) 1.10.64. Displayed at Paris show 1967. To 60 MU Leconfield 3.8.67. To 56 Sqn (T) 26.3.68. To 29 Sqn (S) 1.5.73. To 111 Sqn (G) 8.8.73. To 29 Sqn 22.2.74. To 111 Sqn (F) 15.5.74. SOC 28.11.74 with 2163 hours. To Wattisham dump 4.75. Transported to Binbrook dump 11.76, destroyed 1981.

XP760
C/N 95188 ff R.P. Beamont 26.8.64. 23 Sqn (K) 16.10.64. Crashed into North Sea off

Seahouses, Northumberland 24.8.66 following reheat fire. 428.5 hours. Pilot Al Thurley ejected safely. Wreckage not recovered.

XP761
C/N 95189 ff D. de Villiers 26.8.64. 23 Sqn (N) 27.10.64. To 111 Sqn (Z) 10.11.67. To 60 MU then 111 Sqn (N) 13.1.69. To 11 Sqn (O) 11.10.72. To ASSF and Lightning Servicing School with 2435 hours. Allocated 8438M. To Binbrook dump 10.82. Sold as scrap to W. Whatnell, removed 1.88.

XP762
C/N 95190 ff D. de Villiers 3.9.64. 111 Sqn (M) 26.1.65. To 60 MU then 111 Sqn (coded C) 11.11.69. To 29 Sqn (A) 9.10.74. To 60 MU Leconfield 9.75. SOC 13.11.75 with 2302 hours. Sold as scrap to J. Shackleton and removed 12.75.

XP763
C/N 95191 ff D. de Villiers 11.9.64. 23 Sqn (M) 27.10.64. To Wattisham Mod centre then 29 Sqn (G) 28.7.67. To 60 MU then 29 Sqn (P) 22.9.69. SOC 17.4.74 with 2089 hours. External storage at Wattisham, scrapped on site 10.75.

XP764
C/N 95192 ff T.M.S. Ferguson 19.9.64. 72 Sqn (H) 3.11.64. Wattisham Mod centre then 56 Sqn (V) 3.2.67. To 23 Sqn (later E) 29.3.67. To 60 MU then 29 Sqn (coded C) 10.9.69. To 5 Sqn (S) 27.10.72. To 11 Sqn (O) 19.4.77. To LTF 4.79 (later B and then DB), on loan to 5 Sqn 16.11.81 (later AR). To LTF (DC) 12.3.86. Air display aircraft. To store 28.10.86. WFU 22.1.87 with 2923.15 hours. Allocated 8929M in storage. Subsequently placed in external storage and sold as scrap to W. Whatnell, removed 1.88.

XP765
C/N 95193 ff D. de Villiers 26.9.64. 33 MU Lyneham for storage 27.11.64. To 56 Sqn (N) 29.7.65. To 29 Sqn (A) 10.5.67. SOC 21.11.74 with 2385 hours. To Wattisham dump 4.75. Scrapped and removed 10.75.

XR711
C/N 95194 ff D. de Villiers 6.10.64. 111 Sqn (A) 2.12.64. To 60 MU 24.8.67 then returned to 111 Sqn. SOC 3.11.74, aircraft sank onto runway during take-off. Pilot Eric Steenson uninjured. 1667.25 hours. To Wattisham dump, scrapped 10.75.

XR712
C/N 95195 ff D. de Villiers 12.10.64. 33 MU Lyneham for storage 19.11.64. To 111 Sqn (B) 18.1.65. Crashed 26.6.65 Watergate Bay during emergency diversion to St.Mawgan with engine fire. 145 hours. Pilot A.Doyle ejected safely.

XR713
C/N 95196 ff D. de Villiers 21.10.64. 111 Sqn (coded C) 8.1.65. To 60 MU then 111 Sqn (A) 25.11.71. To 5 Sqn (S) 15.10.74. To LTF (S) 16.3.76. To 11 Sqn (O) 5.9.78. ASSF and LTF loan various periods LAF markings applied. To 5 Sqn (AR) 29.4.82. LTF (later DD and DC) 20.8.85. To Leuchars for BDRT with 3160.50 hours. Allocated 8935M. On display 111 Sqn HAS complex.

XR714
C/N 95197 ff D. de Villiers 14.11.64. 111 Sqn (D) 8.1.65. take-off accident 27.9.66, aircraft sank onto runway during take-off at Akrotiri. Dismantled by 103 MU 12.67, to dump 1.70 with 495 hours.

XR715
C/N 95198 ff D. de Villiers 14.11.64. 111 Sqn (E) 8.1.65. To 60 MU then 29 Sqn (coded R) 24.10.69. Crashed at Blyford Green, Suffolk 13.2.74 following engine fire. Pilot Terry Butcher ejected safely. 1902 hours. Wreckage recovered to Wattisham and subsequently sold to J. Shackleton.

XR716
C/N 95199 ff D. de Villiers 19.11.64. 111 Sqn (F) 4.2.65. Wattisham Mod centre then 111 Sqn (F) 3.8.67. To 60 MU reconciled 16.7.69 for servicing, retained for continuation training. To 226 OCU (716) 1.6.70. To 29 Sqn (U) 30.8.74. To storage then 56 Sqn (U) 30.1.75. To storage then Binbrook ASSF, to LTF 2.12.75. To ASSF then LTF (D later C) 25.11.76. LAF 1983. To 5 Sqn (AS) 10.10.80. To LTF (DE) 5.3.87. To 5 Sqn (AQ) 4.87. Air display aircraft. Flew last F.3 display 29.9.87. To Cottesmore for crash/rescue training 30.9.87 with 2481.05 hours. Allocated 8940M. To dump 1990, parts removed, sold as scrap to G. Johnson, removed 6.94.

XR717
C/N 95200 ff T.M.S. Ferguson 25.11.64. 56 Sqn (B) 26.3.65. To 60 MU then 111 Sqn 30.9.69 prior to ferrying to Akrotiri. To 56 Sqn (B) 1.11.69. To A Sqn A&AEE for continuation training 29.3.72. Stored Boscombe Down 6.73. To MoD(PE) for spares recovery and crash/rescue training. 1598.05 hours. To dump, removed 1982.

XR718
C/N 95201 ff D. de Villiers 14.12.64. 56 Sqn (coded C) 1.4.65. Wattisham Mod Centre then 29 Sqn (coded C) 11.5.67. To 60 MU Leconfield 14.8.69 for servicing, retained for continuation training. To 226 OCU (718) 1.6.70. To BAC for storage 4.9.74. To Wattisham Storage Flight 18.12.74. To ASSF Binbrook 2.76 and 5 Sqn (S) 4.6.76. To LTF (coded C) 24.11.76. To 5 Sqn (P) 10.1.78. Exchanged between 5 Sqn and LTF until assigned to 11 Sqn 8.5.84 coded (BK1). Air display aircraft. To LTF on loan 7.8.85 then LTF (DB later DE). LTF (DA) 29.10.86. To Wattisham 5.2.87 allocated 8932M with 2561.50 hours as BDRT airframe. Stored until placed on dump 1992. To Blyth Valley Aviation group 4.11.92.

XR719
CN 95202 ff D. de Villiers 18.12.64. 56 Sqn (D) 16.3.65. To 60 MU then to Wattisham 17.4.69 assigned to 111 Sqn (Z), returned to 56 Sqn 14.7.69. To 60 MU Leconfield 17.12.71 for storage. To Coltishall 12.1.72 for Lightning Servicing School with 1405 hours. To dump 8.74. Destroyed 1980.

XR720
C/N 95203 ff J.K. Isherwood 24.12.64. 33 MU Lyneham for storage 29.3.65. To 56 Sqn (E) 2.4.65. To Wattisham Mod centre then to Cyprus 11.5.67. To 111 Sqn (Y) 20.5.69. To 56 Sqn (E) 14.7.69. To 60 MU then 29 Sqn 8.10.71. To Binbrook 9.2.73 to 11 Sqn (M later BN). To LTF (DA) 1.9.82. WFU 22.1.87 allocated 8930M. 2880.50 hours. External storage, sold as scrap and removed 1.88.

XR721
C/N 95204 ff D. de Villiers 5.1.65. 56 Sqn (F) 8.4.65. Crashed 5.1.66 at Helmingham following engine failure. Ejection seat malfunctioned and pilot Derek Law was forced to attempt an emergency landing at Bentwaters. Pilot was killed, aircraft destroyed with 220.50 hours.

XR722
C/N 95205 ff D. de Villiers 23.1.65. To storage 7.5.65. Sold to BAC 21.3.68. Converted to F.53 standard as G27-2 subsequently 53-666. To Khamis Mushayt Saudi Arabia, arriving 5.12.69. To 2 Sqn (201). On loan to 6 Sqn. Crashed 6.2.72. 30mm round exploded in starboard cannon bay. Pilot Mo Saad ejected successfully. 354 hours.

XR723
C/N 95206 ff D. de Villiers 2.2.65. Flown to Warton for storage pending conversion to F.6 standard. To 11 Sqn (L) 9.6.67. To 60 MU 20.2.73 then 23 Sqn (later F) 4.6.73. To ASSF Binbrook 3.11.75. To 5 Sqn (D later A) 4.5.77. Crashed into sea off Akrotiri 18.9.79 following engine fire. Pilot Peter carter ejected safely. 2515 hours, wreckage not recovered.

XR724
C/N 95207 ff D. de Villiers 10.2.65. Flown to Warton for storage pending conversion to F.6 standard. To 11 Sqn (M later K) 16.6.67. To ASSF 15.5.79 (dual 5/11 Sqn markings). To LTF (later K) 2.7.79. To 5 Sqn (AV) 7.7.82. To 11 Sqn (BC) 1.11.83. To 5 Sqn (AE) 18.6.86. Tornado radar trials target aircraft fitted with overwing tanks. Transferred to MoD(PE) Warton 11.4.88. To Shawbury for storage 27.7.90 with 4112 hours. Sold to Lightning Association as G-BTSY 25.7.91. Ferry flight to Binbrook 23.7.92 as XR724. Stored externally at Binbrook.

XR725
C/N 95208 ff T.M.S. Ferguson 19.2.65. To Warton pending conversion to F.6 standard. To 23 Sqn (A) 15.8.67. To 5 Sqn 8.12.69 prior to being ferried to Singapore. To 74 Sqn (A) 6.1.70. To 60 MU Leconfield 14.9.71 then Leuchard for ferrying to Cyprus. To 56 Sqn (Y later P) 8.5.72. To Wattisham 21.1.75. To ASSF Binbrook then 5 Sqn (J) 2.6.76. To storage then LTF (F later DF) 14.4.80. To 11 Sqn (BA) 14.10.85. Final flight 17.12.87 with 3870.20 hours. Spares recovery then stored on airfield. Sold to G. Beck; transported to Rossington 16.7.88. Sold to Charles Ross, Binbrook 16.11.91, on private display.

XR726
C/N 95209 ff D. de Villiers 26.2.65. Flown to Warton pending conversion to F.6 standard. To 60 MU reconciled for storage, retained for continuation training. To 5 Sqn (N later AE) 1.2.68. On loan to 11 Sqn and LTF, in use with LAF (coded F) 1982. To 11 Sqn (BE) 15.4.85. To LTF (DF) 20.6.86. To 11 Sqn (BM) 30.4.87. Final flight 22.8.87 with 3976.25 hours. Stored then moved onto airfield. Sold to G. Beck and transported to Rossington 14.7.88. Cockpit section rescued. Scrapped 12.92.

XR727
C/N 95210 ff T.M.S. Ferguson 8.3.65. To Warton pending conversion to F.6 standard. To 23 Sqn (F) 15.9.67. To 60 MU reconciled then 11 Sqn (F) 12.12.73. To ASF then 11 Sqn (G later BG) 4.9.80. To 5 Sqn (AB) 22.2.84. To ASF then 5 Sqn (AB) 25.9.86. To 11 Sqn (BH) 6.10.87. To Wildenrath 10.5.88 with 3944.25 hours. SOC allocated 8963M. Instructional airframe, scrapped on site 1991.

XR728
C/N 95211 ff D. de Villiers 17.3.65. To Warton pending conversion to F.6 standard. To 23 Sqn (D) 1.11.67. To 60 MU Leconfield then Binbrook 24.11.71 prior to ferry flight to Cyprus. To 56 Sqn (D) 16.12.71. To Wattisham 30.1.75. To 60 MU then 56 Sqn (J) 22.10.75. To ASSF Binbrook 17.7.76. On loan to 5 Sqn then LTF (D) 1.8.78. To 11 Sqn (BA later BF and BS) 1.2.82. To ASF 7.87 (JS and Station badge). To 5 Sqn (JS) 5.8.87 and 11 Sqn 4.1.88 (JS) retaining station badge. Sold to Lightning Preservation Group. Flown to Bruntingthorpe 24.6.88 with 3708.40 hours. Preserved by LPG.

XR747
C/N 95212 ff D. de Villiers 2.4.65. To Warton pending conversion to F.6 standard. To 23 Sqn (K) 4.1.68. Wattisham Storage Flight 1.10.74 then 5 Sqn (P) 11.11.74. To ASSF then 5 Sqn (E) 10.2.77. To 11 Sqn (BF). To 5 Sqn (AL) 23.9.85. To LESFT 2.11.87. WFU with 3650 hours. Open storage, sold to G. Beck and moved to Rossington 14.7.88. Nose section to Lightning Flying Club.

XR748
C/N 95213 ff R.P. Beamont 13.4.65. Held pending conversion to F.6 standard but completed to F.3 standard. To 60 MU Leconfield 21.8.67 for storage. To Wattisham for ferry flight preparation to Akrotiri 19.9.67. To 56 Sqn (P) 31.10.67. To 60 MU then 111 Sqn (M) 22.8.72. Crashed North Sea off Yarmouth 24.6.74 following hydraulic failure. 1499 hours. Pilot Kevin Mason ejected safely. Wreckage not recovered.

XR749
C/N 95214 ff T.M.S. Ferguson 30.4.65. Held pending conversion to F.6 standard but completed to F.3 standard. To ASF Wattisham 4.10.67 in preparation for ferry flight to Cyprus. To 56 Sqn (Q) 31.10.67. To 60 MU Leconfield then Coltishall for storage 22.9.71. To 5 Sqn (Q) 30.10.72. LAF 1982. To 11 Sqn (BM later BO) 10.12.82. To LTF (DA) 5.2.85. 56 Sqn markings 5.86. To 11 Sqn and 5 Sqn on loan then LTF (Q) 26.9.86 and 11 Sqn (Q) 17.11.86. To Leuchars 17.2.87 with 2542.05 hours. Allocated 8934M BDRT airframe. Sold to Ken Ward 15.2.92. Teeside Airport 19.12.93. To Peterhead 2003.

XR750
C/N 95215 ff R.P. Beamont 10.5.65. Held pending conversion to F.6 standard but completed to F.3 standard. To 60 MU Leconfield for storage 9.10.67. Held for continuation training. To 56 Sqn (A) 17.12.68. To 60 MU then 226 OCU (750) 22.9.71. To 111 Sqn (N) 6.8.74. On loan to 111 Sqn 9.74. Wattisham Storage Flight 1.10.74. SOC 28.11.74. To dump 1.75 with 1197 hours. Removed as scrap 10.75.

XR751
C/N 95216 ff J.K. Isherwood 31.5.65. Held pending conversion to F.6 standard but completed to F.3 standard. To 60 MU Leconfield for storage 19.1.68. To 226 OCU (751) 2.12.70. To 29 Sqn (Q) 1.4.71. To 5 Sqn (coded R) 10.11.72 including two loan periods to 11 Sqn. To LTF (coded C later A and DA) 8.2.79. To ASSF storage 22.9.82 with 2060 hours. External storage 11.87. Sold to Roy Flood, Castle Air Motors. To display at Lower Tremar, 24.6.88.

F.Mk.6 Interim (F.Mk.6)

XR752
C/N 95217 ff D. de Villiers 16-6.65. AFDS (V) 26.11.65, first Interim F.6 delivery to RAF. To FCTU (V) 31.1.66. To 23 Sqn (U) 26.7.67. To Warton for conversion to full F.6 standard 20.10.67. To Leuchars (W) 17.10.68, pool aircraft. To 23 Sqn (W later G) 1.5.70. To 111 Sqn (Y) 15.5.74. To 5 Sqn (B later H) 10.10.74. To 11 Sqn (D) 21.9.78. To ASSF then 11 Sqn (BH later BL) 14.11.80. WFU 18.12.85 with 3922 hours. Stored both externally and hangared. Sold to R. Austin as scrap, removed 9.87.

XR753
C/N 95218 ff R.P. Beamont 23.6.65. AFDS Binbrook 16.11.65. FCTU (U) 31.1.66. To 23 Sqn (V) 27.7.67. To Warton 21.3.68 for conversion to full F.6 standard. To 60 MU then 5 Sqn (B) 8.10.69. To 60 MU then 23 Sqn (A) 16.8.71. To ASSF Binbrook 3.11.75. To 5 Sqn (F later A) 12.2.76. To 11 Sqn (A later BA) 9.7.80. To 5 Sqn (AG later AC) 7.9.82. To 11 Sqn (BP) 14.12.87. WFU 19.4.88 with 4284.45 hours. Allocated 8969M, flown to Leeming 23.5.88. On display 11 Sqn, later moved to Coningsby (11 Sqn).

XR754
C/N 25219 ff D.M. Knight 8.7.65. Boscombe Down 3.12.65. To 5 Sqn (G) 2.2.66. To Warton 31.1.67 for conversion to F.6 standard. To 23 Sqn (M) 29.2.68. To 60 MU then 23 Sqn (D) 8.6.71. To ASSF Binbrook 3.11.75 then 11 Sqn (E) 23.3.76. To ASSF then 11 Sqn (A) 12.8.77. To 5 Sqn (AE) 30.4.81. To 11 Sqn (BC) 9.12.86. To Honington 22.6.88 with 3898 hours. Allocated 8927M. Crash/rescue training. Sold to Hanningfield Metals, removed as scrap 11.2.92. Nose section to Phil Thacker, subsequently to Aeroventure, Doncaster.

XR755
C/N 95220 ff R.P. Beamont 15.7.65. 5 Sqn (A) 10.12.65. To Warton for conversion to full F.6 standard 14.4.67 then 5 Sqn (O) 23.5.68. To 60MU then 5 Sqn (F) 15.6.76. To 11 Sqn (J later BJ and BF) 13.2.80. Final flight 18.12.87 with 4093.30 hours. Stored on airfield and sold to E. Marshall, removed 27.6.88. On private display, Callington, Cornwall.

XR756
C/N 95221 ff D. de Villiers 11.8.65. 5 Sqn (B) 10.12.65. To Warton for conversion to full F.6 standard 19.2.67. To Leuchars 13.6.68, pool aircraft (U). To 23 Sqn 25.6.68. To 11 Sqn 1.9.68. To 60 MU then 23 Sqn (M) 14.12.70. 11 Sqn (J) 2.6.76. To Binbrook ASSF then 5 Sqn (later G and AG) 11.5.79. To ASSF 2.8.82 (coded F for exercise). To 11 Sqn (BB later BH) 17.1.83. To LESF 28.7.87. Stored then placed on airfield with 3869.50 hours. Dismantled and transported to P&EE Foulness Island 28.6.88. Scrapped on site 1994.

XR757
C/N 95222 ff R.P. Beamont 19.8.65. 5 Sqn (coded C) 21.12.65. To 23 Sqn (coded R) 17.5.67. To Warton 26.1.68 for conversion to full F.6 standard. Leuchars 18.2.69, 11 Sqn (V) pool aircraft. To 60 MU then 11 Sqn (D) 4.5.71. Displayed at Paris show 1971. Binbrook 22.3.72, 11 Sqn (D) 6.6.75. ASF then 11 Sqn (A) 24.11.78. LAF (Y) 1982. 11 Sqn (BE) 7.7.82. To 5 Sqn (AL) 18.7.84. 11 Sqn (BL) 22.7.86. Final flight 21.12.87 with 4316 hours. Stored on airfield, sold to G. Beck and moved to Rossington 15.7.88. Nose section to Waltham, subsequently Grainthorpe, Lincolnshire.

XR758
C/N 95223 ff J.K. Isherwood 30.8.65. 5 Sqn (D) 11.1.66. To Warton for conversion to full F.6 standard 16.3.67. To Leuchars 24.4.68, pooled aircraft ((V). To 23 Sqn on loan then 11 Sqn 26.11.68 for ferry flight preparation. To 74 Sqn (J) 1.2.69. To Warton 16.1.70 by Belfast. To 23 Sqn (E) 21.4.71. To 60 MU then 5 Sqn (B) 7.1.74. To 11 Sqn (J) 21.1.77. ASSF then 5 Sqn (E later F then E again) 4.4.79. To ASSF then 5 Sqn (AF later AH) 22.4.81. To LTF (DF) 23.3.87. To 11 Sqn (F then BF) 16.4.87. To Laarbruch 10.5.88, final flight with 3812.20 hours. Allocated 8964M. BDRT airframe, later scrapped on site 1996.

XR759
C/N 95224 ff R.P. Beamont 9.9.65. 5 Sqn (E) 18.1.66. To 60 MU Leconfield 6.3.67 for storage. To Warton 18.7.67 for conversion to full F.6 standard. To 60 MU 2.8.68 for storage. To 5 Sqn (coded R) 1.11.68. To 5 Sqn A) 28.5.70. To Singapore, 74 Sqn (G) 15.9.70. To 56 Sqn (P) 3.9.71. To Binbrook 20.10.72 for ferrying preparation. To 56 Sqn (P). To Wattisham 21.1.75. ASSF Binbrook 21.2.75. To 11 Sqn (H) 14.7.75. To 5 Sqn (H later AH) 5.9.80. LAF 1982. 11 Sqn then 5 Sqn (AH) 28.7.82. To 11 Sqn (BJ) 7.5.85. Final flight 29.9.87 with 3748.35 hours. Stored on airfield, sold to G. Beck and moved to Rossington 16.7.88. Nose section to Andrew Exton, remainder scrapped 12.92.

XR760
C/N 95225 ff D.M. Knight 20.9.65. 5 Sqn (F) 27.1.66. To Warton 9.1.67 for conversion to full F.6 standard. To 23 Sqn (H) 28.11.67. Displayed at SBAC Farnborough show 1970. To 60 MU then 23 Sqn (H) 3.3.71. To ASSF Binbrook 3.11.75. To 5 Sqn (G later B) 23.7.76. LAF (K) 2.5.82. To 11 Sqn (Z later BD) 21.2.83. 11 Sqn (BL) 16.12.85. Crashed into North Sea off Whitby 15.7.86 following reheat fire with 3317.50 hours. Parts of wreckage recovered. Pilot Bob Bees ejected safely.

XR761
C/N 95226 ff D.M. Knight 30.9.65. 5 Sqn (J) 15.2.66. To 60 MU reconciled then 23 Sqn (P) 8.5.67. To Warton 19.1.68 for conversion to full F.6 standard. To 60 MU for storage then 5 Sqn (A) 4.11.69 prior to ferry to Singapore. To 74 Sqn (B) 6.1.70. To 56 Sqn (A) 6.9.71. To 60 MU then 11 Sqn 29.5.73 prior to ferry flight to Cyprus. 56 Sqn (A) 13.11.73. To Wattisham 21.1.75. To ASSF Binbrook 17.7.76. To 11 Sqn (F later BF) 9.7.79. To 5 Sqn (AC) 12.2.82. Crashed 8.11.84 into North Sea off Donna Nook following engine fire. 3049 hours. Pilot Mike Hale ejected safely.

XR762
C/N 95227 ff J. Carrodus 9.10.65. 5 Sqn (K) 26.2.66. To Warton 16.1.67 for conversion to full F.6 standard. To 23 Sqn (L) 29.12.67. To 60MU then 11 Sqn (H) 8.1.71. Crashed off Akrotiri 7.4.75 (unknown cause) with 2273 hours. Pilot David Hampton killed.

XR763
C/N 95228 ff T.M.S. Ferguson 15.10.65. 5 Sqn (H) 11.2.66. To Warton 3.1.67 for conversion to full F.6 standard. To 23 Sqn (G) 1.11.67. To 11 Sqn (B) 22.2.72. 11 Sqn (BE) 30.10.80. ASSF store then 5 Sqn (later AL and AN) 26.10.82. 5 Sqn (AP) 7.5.87. Crashed off Akrotiri 1.7.87 after ingesting part of towed banner leading to engine failure. 3712 hours. Pilot Dave Chan ejected safely. Wreckage recovered and scrapped, fin on display at Akrotiri.

XR764
C/N 95229 ff J.K. Isherwood 4.11.65. 5 Sqn (L) 1.3.66. To 60 MU then Warton 23.5.67 for conversion to full F.6 standard. On loan to MoT then 60 MU. To 5 Sqn (P) 23.7.68. To Singapore 74 Sqn (E) 15.9.70. To 56 Sqn (E) 10.9.71. Crashed off Akrotiri 30.9.71 with 982 hours following reheat fire. Pilot Richard Bealer ejected safely. Wreckage abandoned.

XR765
C/N 95230 ff R.P. Beamont 10.11.65. 5 Sqn (M) 6.3.66. To Warton 24.2.67 for conversion to full F.6 standard. To 23 Sqn 25.3.68. Pool aircraft (S) used by 23 and 11 Sqn. To 23 Sqn (A) 19.9.69. To 60 MU then 11 Sqn (coded C) 12.2.76. To 5 Sqn (J later AJ) 11.80. Crashed 23.7.81 with 3143 hours off Flamborough Head following engine fire. Pilot Jim Wild ejected safely. Parts of wreckage recovered by Dutch trawler, recovered to Binbrook via Netherlands.

XR766
C/N 95231 ff J. Dell 11.1.66. To FCTU (W) 28.3.66. To 23 Sqn 26.7.67. Crashed 7.9.67 off Montrose following inadvertent spin. 215.15 hours. Pilot Ron Blackburn ejected safely.

XR767
C/N 95232 ff T.M.S. Ferguson 14.1.66. FCTU 27.4.66. To 23 Sqn (S) 19.7.67. To Warton 29.12.67 for conversion to full F.6 standard. To 5 Sqn (S) 24.1.69. To 74 Sqn (E) 6.1.70. Crashed 26.5.70 in Straits of Malacca during night intercept sortie. 680 hours. Pilot John Webster killed. Wreckage not recovered (declared Missing).

T.Mk.5

XS416
C/N B1/ 95001 ff T.M.S. Ferguson 20.8.64. 226 OCU (416) 16.7.65. To 74 Sqn (T) 12.1.66. To 11 Sqn (T) 10.5.67. To 60 MU then ASSF Binbrook 6.12.74. To 11 Sqn (Z later T). To ASSF then LTF (V) 2.5.78. To store then LTF (DU) 3.2.81. To 5 Sqn (AT later AZ) 27.3.84. Final flight 21.12.87 with 3088.10 hours. Stored on airfield then sold to G. Beck and transported to Rossington 15.7.88. Transferred to New Waltham, subsequently to Gainthorpe, Lincolnshire.

XS417
C/N B1/ 95002 ff J. Dell 17.7.64. First production T.5 to fly. To A Sqn A&AEE 29.9.64. To Warton 5.1.65. To 226 OCU (417) 25.5.65. To 23 Sqn (Z) 20.12.65. To Binbrook 20.3.75, loaned back to 23 Sqn. To 65 Sqn (Z) 3.11.75. To LTF (W) then 11 Sqn (T) 17.12.79. To 5 Sqn then 11 Sqn (BT) 10.80. To LTF (DZ) 2.83. Final flight 16.4.87 with 2603.10 hours. Retained prior to move to Boscombe Down, subsequently cancelled. External storage, sold to Newark Air Museum and removed 6.9.88.

XS418
C/N B1/ 95003 ff T.M.S. Ferguson 12.11.64. Handling Squadron Boscombe Down 30.3.65. To 226 OCU (418) 7.5.65. To Binbrook 22.8.74, loan to 5 Sqn then ASSF. Final flight 20.3.75 with 1242.15 hours. Designated for fire training Catterick. Allocated 8531M. Remained at Binbrook, airfield decoy and BDRT. Sold to R. Austin, removed as scrap 9.87.

XS419
C/N B1/ 95004 ff T.M.S. Ferguson 18.12.64. 226 OCU (419) 20.4.65. To 60 MU then 23 Sqn (T) 24.7.74. To Warton as MRCA chase aircraft 2.3.75. To Binbrook 3.11.75, loan to 5 Sqn then 11 Sqn. To LTF (deployed to Coningsby) 23.10.76 (later coded T and X). To ASSF 22.2.77. To 5 Sqn (T) 31.1.78. To LTF (W later DW) 13.5.80. LTF (DV) 26.5.83. Final flight 27.2.87 with 2608.55 hours. Stored on airfield, sold to G. Beck and transported to Rossington 14.7.88. Destroyed 12.92.

XS420
C/N B1/ 95005 ff D.M. Knight 23.1.65. 226 OCU (420) 29.4.65. To Binbrook ASSF then LTF (V) 18.9.76. Loan to 5 Sqn, LTF (DV) 17.12.80. To LESF 26.5.83 with 2296.55 hours. Stored then placed on airfield. Sold to Tadorna Holdings, removed 26.7.88 to Farnborough. To Fenland Aviation Museum 8.5.94. To Farnborough (FAST) Museum 3.9.03.

XS421
C/N B1/ 95006 ff T.M.S. Ferguson 25.2.65. 226 OCU (421) 11.5.65. Loan to AFDS, to 60 MU 22.9.70. To 111 Sqn (T) 4.5.71. Binbrook ASSF 11.10.74 on loan to 23 Sqn (S) 14.11.74. Binbrook ASSF 27.6.75 with 1467 hours. Stored on airfield, transported to Boscombe Down 14.9.76. To P&PEE Foulness Island 27.9.76. Nose section to Nigel Towler, Rayleigh. Rest of airframe scrapped 2.96.

XS422
C/N B1/ 95007 ff T.M.S. Ferguson 24.3.65. 226 OCU (422) 1.6.65. To 111 Sqn (later T) 15.8.69. To 29 Sqn (O) 15.3.72. Loan to 226 OCU 1972. To 56 Sqn (Z) 17.10.72. Loan to MoD – ETPS 2.7.75. Transferred to MoD 28.3.77. Final flight 13.8.87 with 2210 hours. Retained for rescue training. Sold to Wensley Haydon-Baillie and removed 8.89. Transported to AALO, Stennis Airport, US, arriving 20.11.97. Registered N422XS, under restoration to flight standard.

XS423
C/N B1/ 95008 ff D. de Villiers 31.3.65. 226 OCU (423) 1.6.65. To Binbrook ASSF 11.9.74. Stored with 1440.30 hours. Allocated 8532M, assigned to Honington but subsequently retained at Binbrook. Airfield decoy (coded 4). Sold to R. Austin, dismantled and removed as scrap 9.87.

XS449
C/N B1/ 95009 ff D. de Villiers 30.4.65. 226 OCU (449) 15.7.65. To Binbrook ASSF 4.9.74. Final flight with 1435 hours. Allocated 8533M, airfield decoy (coded 5). Sold to R. Austin, dismantled and removed as scrap 9.87.

XS450
C/N B1/ 95010 ff R.P. Beamont 25.5.65. 111 Sqn (T) 6.9.65. To 60 MU then 226 OCU (240) 31.3.70. To Binbrook ASSF 2.9.74, loan to 5 Sqn. To ASSF 24.10.74 with 1782.35 hours. Allocated 8534M assigned to Manston but subsequently retained at Binbrook. Airfield decoy (coded 1). Sold to R. Austin, dismantled and removed as scrap 9.87.

XS451
C/N B1/ 95011 ff D. de Villiers 3.6.65. 5 Sqn (T) 19.11.65. To 60 MU then 226 OCU (451) 24.11.71. To Binbrook ASSF 22.8.74, loan to 5 Sqn then to ASSF and 11 Sqn (X) 17.9.74. To ASSF 17.7.76. To St. Athan 24.11.76 with 1596.30 hours. Transported to Newton 1.4.80 allocated 8503M. Sold to P. Hoar, transported to Carnfield. Sold to Barry Pover, transported to Plymouth Airport 12.9.89. Sold to Mike Beachyhead and shipped to South Africa 9.98. Registered as ZU-BEX, restored to flying condition.

XS452
C/N B1/ 95012 ff D. de Villiers 30.6.65. 226 OCU (452) 20.9.65. To 60 MU then 111 Sqn (T) 11.11.71. To 29 Sqn (X) 12.10.72. To Akrotiri 14.1.74 with 111 Sqn, assigned to 56 Sqn (X) 18.1.74. To Akrotiri Station Flight. To Binbrook 21.5.75. To 11 Sqn (Y) 7.75. Loan to 5 Sqn and LTF. To 11 Sqn (T) 10.5.77. To LTF (Z later DZ) 30.6.80. To 11 Sqn (later BT) 18.3.85. Sold to Arnold Glass, flown to Cranfield 29.6.88 with 3011 hours. Sold to Tony Hulls Consortium 27.11.93. Sold to Mike Beachyhead, shipped to South Africa 9.98. Registered ZU-BBD. Maintained in airworthy condition.

XS453
C/N B1/ 95013 ff R.P. Beamont 6.7.65. 226 OCU (453) 10.9.65. Crashed North Sea off Happisburgh 1.7.66 following undercarriage selection failure. Pilot Geoff Fish ejected safely. 31 hours.

XS454
C/N B1/ 95014 ff D. de Villiers 6.7.65. 74 Sqn (T) 8.10.65. To 226 OCU (454) 12.1.66. Warton 5.4.68 for undercarriage investigations. To MoT and A Sqn A&AEE 18.10.68 for T.5 undercarriage malfunction investigations. To 226 OCU 11.12.68. To Binbrook ASSF then 11 Sqn (Y) 17.9.74. Warton 1.5.75, MRCA chase aircraft. Final flight 11.6.75 with 1449.20 hours. To ASSF Binbrook storage. Allocated to Brawdy but retained at Binbrook 8535M. Airfield decoy (3) and BDRT. To dump 3.77. Sold to Humberside Airport then re-sold to J.R. Clark as scrap, removed 26.9.87.

XS455
C/N B1/ 95015 ff T.M.S. Ferguson 23.9.65. 226 OCU (455) 20.12.65. To Warton 2.3.70 then returned to OCU. To 5 Sqn (T) 9.2.71. Crashed North Sea off Withernsea 6.9.72 with 1086 hours. Hydraulic failure. Pilots Tim Gauvain and R. Verbist (BAF) ejected safely.

XS456
C/N B1/ 95016 ff T.M.S. Ferguson 26.10.65. 56 Sqn (A) 20.12.65. To Akrotiri 10.5.67 (recoded X). To 60 MU reconciled 23.2.73. To Binbrook 18.4.74, 11 Sqn (T). To ASSF then LTF (T later DT) 21.2.77. To storage 10.4.84. LTF (DX) 9.4.86. Final flight 29.9.87 with 2814.10 hours. Open storage 4.88. Sold to T.A. Smith and removed 20.7.88 for private display, Wainfleet.

XS457
C/N B1/ 95017 ff R.P. Beamont 8.11.65. 226 OCU (457) 21.12.65. To 60 MU Leconfield 24.11.71 returning to OCU. To Binbrook ASSF then 11 Sqn (W) 14.5.75. To LTF (later Y) 1.10.75. To ASSF then LTF (Y) 28.8.78. On loan to MoD(PE) Boscombe Down (ETPS) 26.6.79. To 5 Sqn (later AT) 24.7.81. WFU 21.9.87 with 2164.20 hours. Open storage (coded FD5) 1.88. Sold to S. Woods as scrap, removed 4.7.88. Nose section to private collector then North Coates, and to Gainthorpe. To Binbrook for restoration, combined with airframe parts from Saudi T.55 and F.53.

XS458
C/N B1/ 95018 ff D.M. Knight 3.12.65. 226 OCU (458) 2.2.66. To Binbrook ASSF then 5 Sqn 30.9.75. To LTF (later Z) 9.76. To 5 Sqn (T) 16.1.79. Loan to 11 Sqn then returned to 5 Sqn (AT) and into storage. To 11 Sqn (BT) 29.4.82. To LTF (DX) 19.10.84. Loan to 11 Sqn then LTF (DY) 9.86. To Warton 9.86 for Austrian demonstration flights. To LESF used by 5 and 11 Sqn, with LTF markings. Sold to Arnold Glass and flown to Cranfield 29.6.88 with 3168 hours. Sold to Cypriot buyer then re-sold to Consortium led by Tony Hulls 1995. Restored to taxy condition 1986. Sold to Russell Carpenter 2003, remaining in taxy condition at Cranfield.

XS459
C/N B1/ 95019 ff J. Dell 18.12.65. 226 OCU (459) 13.4.66. To 60 MU then 29 Sqn (T) 29.2.72. Stored at Wattisham then 56 Sqn (X) 6.2.75. To LTF later X and DX) 27.5.76. LTF (DW) 17.5.84. To Warton 9.86 for Austrian demonstration flights. To 5 Sqn (W later AW) 17.12.86. Final flight 18.3.87 with 2306.45 hours. Open storage 22.4.88. Sold to Tadorna Holdings, dismantled and removed 26.7.88 to Narborough. To Fenland Aviation Museum, Wisbeach 8.5.94.

XS460
55.710; C/N B1/ 95020 ff T.M.S. Ferguson 2.2.66. On loan to BAC then sold to BAC 6.5.66. Converted to Saudi T.55 prototype, ff as T.55 19.1.67. Crashed on landing at Warton 7.3.67, in crosswinds. Pilot Jimmy Dell and passenger P. Williams unhurt. 14.53 hours.

XV328
C/N B1/ 95021 ff D. de Villiers 22.12.66. 60 MU Leconfield for storage 31.1.67. To 29 Sqn (Z) 7.4.67. To 60 MU then 5 Sqn (T) 19.5.76. To LTF (Y later DY and DU) 28.2.80. To 11 Sqn (BZ) 10.10.87. Sold to Arnold Glass and flown to Cranfield 29.6.88 with 3020.40 hours. Sold to N. Martin as scrap 11.94, removed 5.12.94. Nose section retained by N. Martin, on display at Bruntingthorpe.

XV329
C/N B1/ 95022 ff D. de Villiers 30.12.66. Sydenham 3.3.67 for preparation for shipment to Singapore. To 74 Sqn (T) 30.6.67. Returned to Sydenham 16.10.71 allocated to 60 MU. Flown to Leconfield 14.12.71 on final flight with 902 hours. WFU following severe corrosion caused during shipment to Singapore. To dump at Leconfield 4.74, sold as scrap 3.5.74 and removed, nose section remaining on dump until 1977.

F.Mk.6

XR768
C/N 95233 ff R.P. Beamont 24.11.65. First full production standard F.6 to be completed. To 74 Sqn (A) 1.8.66. 60 MU 16.1.70 then 5 Sqn (P) 15.12.70. Crashed 29.10.74 with 2144 hours, off Mablethorpe following reheat fire. Pilot Tex Jones ejected safely.

XR769
C/N 95234 ff J.K. Isherwood 1.12.65. To A Sqn A&AEE 12.9.66. To Warton then 74 Sqn (B) 3.11.66. Ferried to Singapore 12.2.67. To 60 MU 12.1.70 then Binbrook, on loan to 5 Sqn 3.70. To 11 Sqn (J) 13.5.71. 11 Sqn B later BB, BD, BG and BE) 6.4.78. To 5 Sqn (AM) 29.9.87. To 11 Sqn 23.2.88. Crashed 11.4.88 North Sea off Easington with 4070.05 hours. Engine fire, pilot Dick Coleman (RAAF) ejected safely.

XR770
C/N 95235 ff R.P. Beamont 16.12.66. Displayed SBAC Farnborough show 1966 in Saudi markings. To 74 Sqn (coded C) 26.9.66. To Tengah 1971. To 23 Sqn (L) 22.5.72. To 56 Sqn (D) 30.6.75. To Binbrook ASSF 17.7.76. To 5 Sqn (B later A) 8.6.78. To 11 Sqn 28.7.80. To 5 Sqn (AA) 26.11.80. To 11 Sqn (X) 2.3.83, 5 Sqn 21.4.83, 11 Sqn 12.5.83. 5 Sqn (AA later AJ then AA) 13.7.83. To 11 Sqn (BN) 4.88. To LESF 11.5.88, LTF markings (JS). 4022 hours. Dismantled and removed to Lacebt 17.7.88. To Waltham then Gainthorpe. To 5 Sqn for display, Waddington.

XR771
C/N 95236 ff T.M.S. Ferguson 20.1.66. 74 Sqn (D) 24.10.66. To 56 Sqn (coded C) 3.9.71. To 60 MU then Leuchars prior to ferrying to Cyprus, returning to Wattisham 30.1.75. To Binbrook store 17.7.76. To 5 Sqn (coded C) 21.11.78. To 11 Sqn (Y later BA) 1.3.83. 5 Sqn (AN) 20.3.86. 11 Sqn (BM) 4.1.88. Final flight 18.3.88 with 3553.55 hours. Sold to Magnatec. Removed to Midland Air Museum Coventry 15.7.88.

XR772
C/N 95237 ff J. Dell 10.2.66. 74 Sqn (E) 21.10.66. To 60 MU then 5 Sqn (E) 7.10.70. To ASSF store then 11 Sqn (coded C) 29.9.77. To LTF 4.3.81 (11 Sqn markings). To 11 Sqn (BB) 30.7.81. To 5 Sqn 7.7.82. To 11 Sqn 10.8.82. To 5 Sqn (AD) 12.7.84. Crashed 6.3.85 off Spurn Point with 3842 hours. Entered spin. Pilot Martin Ramsay ejected but was killed. Wreckage recovered via Grimsby, tail fin to Binbrook Village (Primary School).

XR773
C/N 95238 ff R.P. Beamont 28.2.66. 74 Sqn (F) 7.11.66. To 56 Sqn (N) 5.9.71. To 60 MU via Luqa 17.8.73. Binbrook 18.1.74 for preparations prior to ferry flight to Cyprus. 56 Sqn (N) 12.2.74. To Wattisham 21.1.75. To 5 Sqn (B later A) 3.3.75. To 11 Sqn (D) 27.7.76. To 5 Sqn (AH) 8.6.81. To LTF on load (F) 24.9.82. To 5 and 11 Sqns various periods on loan. To 5 Sqn (AF) 23.2.83. To 11 Sqn (BD) 5.11.84. To LTF (DF) 24.4.85. To 5 Sqn (AB) 21.1.86. To 11 Sqn (BR) 13.8.87. To Boscombe Down to storage pending Tornado radar trials programme 27.6.88. To Warton 11.7.89. Sold to Barry Pover, flown to Exeter 23.12.92. Sold to Mike Beachyhead 2.97. Shipped to Cape Town, re-flown 1.11.01. Current with Thunder City fleet.

XS893
C/N 95239 ff R.P. Beamont 15.3.66. 74 Sqn (G) 23.11.66. Stored as spares source 11.1.68. To 74 Sqn 1.10.68. Crashed 12.8.70 into sea near Changi following failure of port landing gear. Pilot M.D. Rigg ejected safely. 857.40 hours. Wreckage not recovered.

XS894
C/N 95240 ff R.P. Beamont 18.3.66. 5 Sqn (F) 3.1.67. Crashed into North Sea off Flamborough Head 8.9.70 with 650.45 hours. Pilot Capt. Shaffer (USAF) failed to eject but not found. Aircraft salvaged intact, to Binbrook then Farnborough. Cause not determined.

XS895
C/N 95241 ff R.P. Beamont 6.4.66. 74 Sqn (H) 5.12.66. To 60 MU then 5 Sqn (B) 28.3.72. To 23 Sqn (N) 6.11.72. To 111 Sqn (Z) 15.5.74. To Binbrook store 30.1.76. To 5 Sqn (B) 26.1.79. To 11 Sqn then 5 Sqn (AL). To store 29.9.80. To 5 Sqn 30.7.81. 5 Sqn (AK) 1.10.81. To LTF 13.4.84. To 11 Sqn (BC) 25.6.85. Final flight 22.12.86 with 3275 hours. ASSF store, on airfield 4.88. Allocated to RAE Farnborough. Wings and tail fin removed to Pendine 28.6.88. Remainder sold as scrap 1977.

XS896
C/N 95242 ff J.K. Isherwood 25.4.66. 74 Sqn (J) 7.12.66. Crashed 12.9.68 on approach to Tengah, pilot Pete Thompson killed. 400 hours.

XS897
C/N 95243 ff R.P. Beamont 10.5.66. 74 Sqn (K) 21.12.66. To 56 Sqn (S) 5.9.71. To 60 MU then Binbrook prior to ferry flight to Cyprus. To 56 Sqn 9.2.73, to Wattisham 30.1.75. Binbrook ASSF 17.7.76. To 11 Sqn (H later BE and BC) 23.9.77. To 5 Sqn (AC) 24.1.86. Final flight 14.12.87 with 3391.55 hours. Open storage 4.88. Sold to G. Beck, removed to Rossington 15.7.88. To Firbeck then Aeroventure, Doncaster 4.6.00.

XS898
C/N 95244 ff D. de Villiers 20.5.66. 5 Sqn (K) 9.1.67. To ASSF store then 5 Sqn (J) 3.7.78. 5 Sqn (AK) 14.3.83. To 11 Sqn (BM later BD) 13.5.86. Sold to Arnold Glass with 3488.20 hours. Flown to Cranfield 30.6.88. Sold to N. Martin and scrapped 2.12.94. Nose section to Bruntingthorpe then sold to Tony Collins, Lavendon, 29.10.95.

XS899
C/N 95245 ff D. de Villiers 8.6.66. 5 Sqn (G) 23.1.67. To 60 MU then 23 Sqn (E) 4.2.74. To ASSF Binbrook 3.11.75. To 5 Sqn (later L, C and E) 12.1.76. To 11 Sqn (coded C) 31.5.79. 11 Sqn (BC later BL) 25.2.81. To 5 Sqn (AA) 22.10.81. To 5 Sqn (AJ later AM) 2.4.84. To 5 Sqn (AF) 6.11.87. To 11 Sqn (BL) 4.1.88. Sold to Arnold Glass with 3701.30 hours, flown to Cranfield 28.6.88. Sold to N. Martin 11.94, scrapped 2.12.94. Nose section to Bruntingthorpe, to Coltishall 3.96.

XS900
C/N 95246 ff R.P. Beamont 20.6.66. 5 Sqn (M) 31.1.67. Crashed 24.1.68 on take-off from Lossiemouth with 292 hours. Outbreak of fire led to loss of control. Pilot Stuart Miller ejected safely. Salvage attempted but abandoned.

XS901
C/N 95247 ff D. de Villiers 1.7.66. 5 Sqn (D) 20.2.67. To 60 MU then Binbrook prior to ferry flight to Cyprus. 56 Sqn (T) 28.2.72. To Wattisham 30.1.75. To Binbrook store then Coningsby and returned to Binbrook. To 11 Sqn (G) 5.9.77. To ASSF then 11 Sqn (BH) 20.12.83. To 5 Sqn (AH) 10.7.86. To 11 Sqn (later BK) 21.3.88. To Bruggen 10.5.88 with 3781.10 hours. Allocated 8965M for BDRT. Scrapped on site 9.92.

XS902
C/N 95248 ff R.P. Beamont 14.7.66. 5 Sqn (J) 1.3.67. Crashed North Sea off Spurn Point 26.5.71 following engine fire warnings. Pilot Ali Mackay ejected safely. 1051 hours. Wreckage not recovered.

XS903
C/N 95249 ff D. de Villiers 17.8.66. 5 Sqn (A later C and A) 16.3.67. Displayed at Paris show 1967. To 11 Sqn (later BC) 14.10.80. To 5 Sqn (AM later AO) 19.8.84. To 11 Sqn (BE later BA) 16.7.87. Final flight to Elvington 18.5.88 with 4054.35 hours. To Yorkshire Air Museum.

XS904
C/N 95250 ff D. de Villiers 26.8.66. 11 Sqn (A) 18.4.67. Loan to MoD(PE) 16.10.72. To 60 MU and ASSF returning to 11 Sqn (A then B). 11 Sqn (D) 1.2.80. To 5 Sqn 30.7.80. 11 Sqn (BD) 11.80. 11 Sqn (BM) 23.8.84. ASF then 11 Sqn (BQ) 16.3.87. To MoD(PE) Warton 8.4.88, Tornado radar trials programme. Sold to Lightning Preservation group, flown to Bruntingthorpe 21.1.93 with 4159.34 hours. Preserved in taxy condition.

XS918
C/N 95251 ff R.P. Beamont 22.9.66. 11 Sqn (B) 14.4.67. Crashed 4.3.70 into North Sea off Leuchars following reheat fire. 866 hours. Pilot Tony Doidge ejected but was killed. Wreckage partially salvaged.

XS919
C/N 95252 ff J.K. Isherwood 28.9.66. 11 Sqn (coded C) 18.5.67. To 60 MU then Binbrook prior to ferrying to Cyprus. 56 Sqn (coded R). To Wattisham 22.1.75. To 5 Sqn (coded C) 30.6.76. ASSF store then 5 Sqn (F) 18.1.78. 5 Sqn (AD later AL) 11.2.81. To 11 Sqn (BN) 1.7.84. Final flight 14.3.88 with 3987.25 hours. External storage 31.3.88. Sold to Roy Flood, Castle Air Motors. Removed to Lower Tremar, Cornwall 24.6.88. Sold to Ray Hemming, moved to Devonport, sold to Wonderland Pleasure Park, Notts, 3.99.

XS920
C/N 95253 ff D. de Villiers 25.10.66. 74 Sqn (L) 5.12.66. To 60 MU then 11 Sqn (F later E) 12.8.70. 11 Sqn (B) 18.9.79. 11 Sqn (BB) 10.80. To 5 Sqn, loan, then (AL later AF) 4.12.83. Crashed 13.7.84 Heuslingen, Germany, with 3645 hours. Hit power cables at low level, pilot Dave Frost killed.

XS921
C/N 95254 ff D. de Villiers 17.11.66. 74 Sqn (M) 21.12.66. To 56 Sqn (Q) 7.9.71. To 60 MU then 11 Sqn (L) 2.8.74. To 5 Sqn (H) 3.11.77. To 11 Sqn (F) 11.11.78. To 5 Sqn (AB) 23.3.82. To 11 Sqn (BA) 6.3.85. Crashed 19.9.85 off Flamborough Head with control failure. 3061 hours. Pilot Craig Penrice ejected safely.

XS922
C/N 95255 ff D. de Villiers 6.12.66. To 5 Sqn (H) 30.12.66. To 60 MU and Warton, returned to 5 Sqn. To 11 Sqn (L) 18.9.76. To ASF then 5 Sqn (coded C) 3.4.80. Coded (A then AC) 11.80. To 5 Sqn (later AG) 29.10.84. To ASF then 5 Sqn (AF) 7.10.86. To 11 Sqn (BJ) 4.11.67. Final flight to Wattisham 14.6.88. Allocated 8973M BDRT airframe. Sold to Hanningfield Metals, removed as scrap 28.1.92. Nose section to Tony Dyer, to private collection 2001.

XS923
C/N 95256 ff D.M. Knight 13.12.66. 5 Sqn (coded C) 11.1.67. To 60 MU then 5 Sqn (A) 29.9.70. 5 Sqn (coded C) 1.11.74. To 11 Sqn (J) 8.8.78. To 11 Sqn (BG) 24.6.82. To 5 Sqn (AA) 18.1.85. To LTF 21.1.86 (DF). To 11 Sqn (BE) 20.6.86. Sold to Arnold Glass, flown to Cranfield 30.6.88 with 3997.50 hours. Sold to Nev Martin, scrapped 2.12.94. Nose section to Roy Jerman, Welshpool.

XS924
C/N 95257 ff T.M.S. Ferguson 11.1.67. 5 Sqn (E) 24.2.67. Crashed near Binbrook 29.4.68 with 407 hours. Pitch-up during formation flypast. Pilot A.J. Davey was killed. Wreckage recovered to Farnborough.

XS925
C/N 95258 ff R.P. Beamont 26.1.67. 5 Sqn (L) 1.3.67. To Samlesbury then Binbrook 24.2.70. To 11 Sqn (J) 15.8.75. To 5 Sqn (L) 15.10.75. To 5 Sqn (D later AD) 19.7.79. To 11 Sqn (BD) 13.6.85. To 5 Sqn (AP and APc) 24.2.86. Final flight 21.7.87 with 4015.30 hours. Allocated 8961M, stored prior to removal to Hendon for RAF Museum 28.4.88.

XS926
C/N 95259 ff J. Cockburn 30.1.67. 5 Sqn (B) 20.3.67. Crashed 22.9.69 off Flamborough Head following loss of control. 709 hours. Pilot C.B. Neel (USAF) ejected safely.

XS927
C/N 95260 ff R.P. Beamont 15.2.67. 74 Sqn (N) 3.4.67. To 60 MU then 11 Sqn (M) 24.5.72. To 23 Sqn (O) 12.10.72. To 5 Sqn (G) 18.3.76. To ASSF then 11 Sqn (H later BH and BB) 7.3.79. Emergency landing at Swinderby, returned to Binbrook and WFU 13.11.86 with 3575.35 hours. External storage 25.3.88. Wings and tail fin removed and transported to P&EE Foulness Island 28.6.88. Remainder scrapped on site 3.94.

XS928
C/N 95261 ff R.P. Beamont 28.2.67. 11 Sqn (D) 4.4.67. To Binbrook prior to ferry flight to Singapore, arriving 11.12.69. 74 Sqn (L) 6.1.70. To Warton by Belfast 3.11.70. To 56 Sqn (E) 17.8.72. To Wattisham 20.5.75. To 5 Sqn (K later L and F) 18.9.76. To 5 Sqn (AJ later AU) 10.81. To 11 Sqn (BJ) 20.6.83. To 5 Sqn (AH) 19.8.85. To Warton 13.6.88 for Tornado radar trials programme. WFU 1992 with 3809.45 hours. Sold to Barry Pover for spares recovery, airframe retained at Warton, placed on display 9.99.

XS929
C/N 95262 ff T.M.S. Ferguson 1.3.67. 11 Sqn (E) 26.4.67. To 56 Sqn (L) 12.8.73. Returned to Wattisham 22.1.75. To Binbrook 17.7.76 and 11 Sqn (E later BC). To store then LTF (DG) 21.8.85. To 11 Sqn (BG) 2.4.86. Final flight to Akrotiri 19.5.88 with 3601 hours. Allocated 8970M, on display on plinth 23.4.89.

XS930
C/N 95263 ff R.P. Beamont 20.3.67. 11 Sqn (F) 25.5.67. To 74 Sqn (F) 24.5.70. Crashed 27.7.70 at Tengah following loss of control on take-off. Pilot Frank Whitehouse ejected late and was killed. 785.55 hours, scrapped on site 9.70.

XS931
C/N 95264 ff R.P. Beamont 31.3.67. 11 Sqn (G) 31.5.67. To 5 Sqn then to 11 Sqn. ASSF store 17.7.76. To 5 Sqn (G) 13.12.77. Crashed North Sea off Hornsea 25.5.79 following loss of control. Pilot Pete Coker ejected safely. 2910 hours. Remains recovered to North Coates, subsequently sold as scrap.

XS932
C/N 95265 ff R.P. Beamont 20.4.67. 11 Sqn (H) 21.6.67. To 60 MU then Leuchars prior to delivery to Cyprus. To 56 Sqn (J later R) 9.11.71. To 60 MU then Binbrook ASSF 17.7.76. To Coningsby for storage 8.77 then Binbrook 1979. 5 Sqn (F later AM, AC and AG) 13.3.79. Final flight 7.11.87 with 3635.30 hours. To storage, onto airfield for storage 12.5.88. Sold to G. Beck and transported to Rossington 14.7.88. Nose section sold to Hugh Trevor, moved to Bruntingthorpe, to Shoreham and FAST Museum, Farnborough. Remainder of airframe scrapped 4.12.92.

XS933
C/N 95266 ff J. Cockburn 27.4.67. 11 Sqn (J) 23.6.67. To 60 MU then 56 Sqn (K) 9.11.71. To Wattisham 30.1.75. To ASSF Binbrook then Coningsby for storage 28.10.76. To 5 Sqn (G) 20.6.77. Loaned to Warton. 11 Sqn (BE) 10.10.83. To 5 Sqn (AJ) 15.1.86. Final flight 30.10.87 with 3663.50 hours. Stored on airfield 25.3.88. Sold to S. Woods as scrap and removed 30.6.88. Nose section to Tadorna Holdings, Narborough, subsequently to Steve Jones, Farnham.

XS934
C/N 95267 ff J. Cockburn 11.5.67. 11 Sqn (K) 3.7.67. Displayed Paris show 1971. To 60 MU prior to ferry flight to Cyprus. To 56 Sqn (B) 16.12.71. Crashed 3.4.73 Limassol Bay, with 1816 hours following fire in engine bay. Pilot Al Greer ejected safely. Parts of wreckage recovered.

XS935
C/N 95268 ff R.P. Beamont 29.5.67. To 60 MU 18.7.67, storage and continuation training. To 23 Sqn (J) 3.1.68. To 5 Sqn (B) 30.1.76. To ASF then 5 Sqn (J later AB and AK) 11.7.80. Final flight 8.9.87 with 3602.30 hours. Spares recovered then placed in open storage 29.4.88. Sold to G. Beck and removed to Rossington 15.7.88. Scrapped 4.12.92.

XS936
C/N 95269 ff J. Cockburn 31.5.67. To 60 MU for storage 27.7.67. To 23 Sqn (B) 22.8.67. Displayed at Toronto show 1968. To Binbrook ASSF 3.11.75 then 60 MU for storage 21.4.76. To 11 Sqn (G) 2.6.76. To 5 Sqn (AK later AL) 28.4.81. To LTF 20.7.82 (later DF). To 11 Sqn (L) 3.6.83. To 5 Sqn (L) 13.7.83. To LTF (DF) 25.11.83. To 5 Sqn (AS later AB) 29.5.85. Final flight 24.11.87 with 3961.50 hours. Open storage 29.4.88. Sold to Roy Flood, Castle Air Motors, removed to Liskeard 23.6.88. On display at Castle Air Motors.

XS937
C/N 95270 ff J. Cockburn 26.6.67. 23 Sqn (coded C) 21.8.67. To ASSF Binbrook 2.9.75. To 11 Sqn (M later K) 29.1.76. Crashed 30.7.76 following failure of starboard main undercarriage. Abandoned off Flamborough Head with 2317 hours. Pilot Simon Manning ejected safely. Wreckage not recovered.

XS938
C/N 95271 ff J. Cockburn 30.6.67. Last production aircraft for RAF. 23 Sqn (E) 28.8.67. To 5 Sqn (E) 25.7.68. To 23 Sqn (E) 13.8.68. Crashed 28.4.71 off Leuchars following reheat fire. 1233.45 hours. Pilot A.C. McLean ejected safely. Wreckage partially recovered.

F. Mk.52 (Saudi Arabia)

52-655 (see XN767)
52-656 (see XN770)
62-657 (see XN796)
52-568 (see XN797)
52-659 (see XN729)

T.Mk.54 (Saudi Arabia)

54-650 (see XM989)
54-651 (see XM992)

F.Mk.53 (Saudi Arabia)

53-666
C/N 95205; Former XR722. ff 23.1.65. Modified to F.53 standard, ff 19.10.66. 1 Squadron, 2 Squadron (201). Crashed 6.2.72 while on loan to 6 Squadron. 364 hours.

53-667
C/N 95272 ff T.M.S. Ferguson 13.7.67. To Saudi Arabia 20.9.68. Dhahran 15.4.70. 2 Squadron (202). 13 Squadron (1301). 2 Squadron (221). Crashed 3.9.85 north of Tabuk with reheat fire.

53-668
C/N 95273 ff R.P. Beamont 4.9.67. To Saudi Arabia 8.11.68. Khamis Mushayt 21.6.72. Stored, later 6 Squadron. 2 Squadron (201 later A). 14.1.86 returned to Warton from Tabuk as ZF577. 2071.36 hours. To Portsmouth Marine salvage.

53-669
C/N 95274 ff J. Cockburn 12.9.67. Jeddah 11.10.68. Reserve aircraft stored at Riyadh. Crashed 21.4.79 near Tabuk. Ran out of fuel.

53-670
C/N 95275 ff T.M.S. Ferguson 12.10.67. Jeddah 8.11.68. Stored at Riyadh 1971. 2 Squadron (202 later B). To Warton 14.1.86 from Tabuk as ZF578. 1886.18 hours. To Cardiff Airport on display.

53-671
C/N 95276 ff J. Cockburn 2.11.67. Jeddah 11.10.68. Dhahran 1.71. To 2 Squadron (203 later C) 8.70. To Warton 14.1.86 from Tabuk as ZF579. 2119.42 hours. To Portsmouth Marine Salvage.

53-672
C/N 95277 ff R.P. Beamont 28.11.67. Jeddah 18.11.68. Dhahran, 1.70. To LCU and 2 Squadron (204 later D). To Warton 14.1.86 from Tabuk as ZF580. 2304.54 hours. On display, Samlesbury factory.

53-673
C/N 95278 ff R.P. Beamont 4.12.67. Jeddah 23.8.68. Stored at Riyadh 9.71. 2 Squadron (205). Crashed 22.9.80, collided with 53-680 near Khamis Mushayt.

53-674
C/N 95279 ff T.M.S. Ferguson 12.12.67. Jeddah, 18.11.68. Dhahran 22.1.70, 2 Squadron (205) 8.70. Crashed 28.9.72 off coast of Bahrain.

53-675
C/N 95280 ff R.P. Beamont 19.12.67. Jeddah 16.9.68. Stored at Riyadh 4.71. 2 Squadron (206 later E). 14.1.86 returned to Warton from Tabuk as ZF581. 1972.42 hours. To Portsmouth Marine Salvage.

53-676
C/N 95281 ff R.P. Beamont 15.1.68. Jeddah 20.9.68. Stored at Riyadh 4.71. 2 Squadron (210 later G, 207 and F). 22.1.86 returned to Warton from Tabuk as ZF582. 1881.24 hours. To Portsmouth Marine Salvage.

53-677
C/N 95282 ff P. Ginger 31.1.68. Jeddah. Stored at Riyadh 4.71. 2 Squadron (208). 4.9.83 crashed during night sortie.

53-678
C/N 95283 ff T.M.S. Ferguson 13.2.68. Last F.53 built at Samlesbury. To Jeddah 23.8.68. Stored at Riyadh 4.71. 21.4.79 crashed after running out of fuel.

53-679
C/N 95284 ff T.M.S. Ferguson 4.3.68. Jeddah 16.9.68. Dhahran 7.4.70. 2 Squadron (206) 8.70, loaned to 6 Squadron 2.72, to 6 Squadron 4.72. 13 Squadron (1302), 2 Squadron (220 later S). 22.1.86 returned to Warton from Tabuk as ZF590. 2281.36 hours. To Portsmouth Marine Salvage.

53-680
C/N 95285 ff R.P. Beamont 18.3.68. Jeddah, 23.7.68. Khamis Mushayt 21.6.72. 6 Squadron (305). 22.9.80 destroyed in collision with 53-673.

53-681
C/N 95286 ff R.P. Beamont 28.3.68. Jeddah 1.7.68 . Khamis Mushayt 7.9.72. 6 Squadron (306), 2 Squadron (210 later H). 14.1.86 returned to Warton from Tabuk as ZF583. 1885. 6 hours. Last Lightning test flown by R.P. Beamont. To Solway Aviation Museum, Carlisle.

53-682
C/N 95287 ff P. Millet 5.4.68. Jeddah 1.7.68. Khamis Mushayt 7.9.72. 6 Squadron (307), 2 Squadron (211 later J). 22.1.86 returned to Warton from Tabuk as ZF584. 1975 hours. On display, GEC-Marconi, Edinburgh.

53-683
C/N 95288 ff J.L. Dell 23.4.68. Jeddah 11.3.69. Khamis Mushayt 5.12.69. Dhahran 7.70. 2 Squadron (207) 9.70. LCU, 2 Squadron (207 later 212 and K). 14.1.86 returned to Warton from Tabuk as ZF585. 2052.18 hours. To Portsmouth Marine Salvage.

53-684
C/N 95289 ff T.M.S. Ferguson 10.5.68. Jeddah 18.11.68. Dhahran 25.1.70. 2 Squadron (208) 8.70. Served with LCU, 2 Squadron (208), 13 Squadron (1303). Crashed on take-off from Dhahran 30.6.80.

53-685
C/N 95290 ff T.M.S. Ferguson 29.5.68. Jeddah 31.1.69. Dhahran 16.4.70. 2 Squadron (209) 8.70. Served with LCU, 2 Squadron (209), 13 Squadron (1304), 2 Squadron (222 later U). 14.1.86 returned to Warton from Tabuk as ZF591. 2110.24 hours. To Portsmouth Marine Salvage.

53-686
C/N 95291 ff T.M.S. Ferguson 11.6.68. Static display 1968 Farnborough show. To Jeddah 17.4.69. Khamis Mushayt 7.12.69. 2 Squadron 8.70. LCU, 2 Squadron (201), 13 Squadron (1305), 2 Squadron (223 later V). 22.1.86 returned to Warton from Tabuk as ZF592. 2297.12 hours. To Portsmouth Marine Salvage.

53-687
C/N 95293 ff P. Millet 5.7.68. Flying display at 1968 Farnborough show. Jeddah 17.4.69. Khamis Mushayt 7.12.69. 2 Squadron 5.70. LCU 8.70. 2 Squadron (F), LCU, 13 Squadron (1306), 2 Squadron (224). Withdrawn, Tabuk 1984.

53-688
C/N 95294 ff P. Ginger 12.7.68. Jeddah 17.4.69. Khamis Mushayt 12.69. 6 Squadron 3.70. LCU, 6 Squadron, 2 Squadron (213 later L). 22.1.86 returned to Warton as ZF586. 1938.48 hours.

53-689
C/N 95295 ff P. Ginger 17.7.68. Jeddah 18.11.68. Storage at Riyadh 4.71. 2 Squadron (J later 214). 27.7.84 crashed at Tabuk. 1781.12 hours.

53-690
C/N 95296 ff T.M.S. Ferguson 20.8.68. Crashed 4.9.68, at Pilling (Fylde) after control failure. Pilot J. Cockburn ejected safely. Fourth flight.

53-691
C/N 95297 ff J. Cockburn 29.8.68. Jeddah 31.1.69. Stored at Riyadh 4.71. 2 Squadron (215 later N). 22.1.86 returned to Warton as ZF587.1947.24 hours. To Portsmouth Marine Salvage.

53-692
C/N 95298 ff J. Cockburn 24.9.68. Jeddah 17.4.69. Khamis Mushayt 12.69. 6 Squadron 3.70. 6 Squadron (experimental camouflage 'L'), 13 Squadron (1307), 2 Squadron (225 later X). 22.1.86 returned to Warton as ZF593. 2130.6 hours. On display, Robins AFB, Georgia, USA.

53-693
C/N 95300 ff T.M.S. Ferguson 9.10.68. Jeddah 23.5.69. Khamis Mushayt 3.12.69. 2 Squadron 7.70. LCU 8.70. 2 Squadron (L), LCU, 2 Squadron (216 later O). 14.1.86 returned to Warton as ZF588. 2005.12 hours. To East Midlands Aeropark.

53-694
C/N 95301 ff P. Millet 17.10.68. Jeddah 3.6.69. Khamis Mushayt 3.12.69. LCU 10.11.70. Dhahran 18.4.73. 11.9.76 crashed near Khamis after entering spin.

53-695
C/N 95302 ff J.L. Dell 30.10.68. Jeddah 23.5.69. 6 Squadron 3.70. Riyadh for modifications 24.11.72. 6 Squadron, 2 Squadron (Mand 217). 28.9.81 destroyed at Tabuk during training sortie.

53-696
C/N 95303 ff J. Cockburn 14.11.68. Jeddah 3.6.69. Stored until 11.70. LCU, 13 Squadron (1308), 2 Squadron (226 and Y). 14.1.86 returned to Warton as ZF584. 2057.6 hours. To North east Aviation Museum, Sunderland.

53-697
C/N 95304 ff D. Eagles 29.11.68. Jeddah 26.8.69. Crashed 3.5.70, near Yemeni border during reconnaissance after being hit by ground fire.

53-698
C/N 95305 ff D. Eagles 18.12.68. Jeddah 3.6.69. Khamis Mushayt 3.12.69. 2 Squadron 7.70. LCU 8.70. 2 Squadron, LCU, 13 Squadron (1309), 2 Squadron (219). Withdrawn 1984.

53-699
C/N 95306 ff J. Cockburn 23.12.68. Jeddah,3.6.69. Khamis Mushayt 12.69. 6 Squadron 3.70. Riyadh for modifications 24.11.72. 6 Squadron, 13 Squadron (1310), 2 Squadron (227). 8.85 on display (on plinth) at Tabuk.

F.Mk.53 (Saudi Arabia)

53-700
C/N 95317 ff P. Ginger 29.6.72. Last production Lightning. Partially completed airframe finished to replace 53-690, which crashed before delivery. To Saudi Arabia 4.9.72. 6 Squadron, 2 Squadron (218 later Q). 14.1.86 returned to Warton as ZF589. 2045.6 hours. To Portsmouth Marine Salvage.

F.Mk.53K (Kuwait)

53-412
C/N 95292 ff P. Millet 21.6.68. Jeddah 18.12.68. Coded C. Stored early 1980s.

53-413
C/N 95299 ff T.M.S. Ferguson 13.9.68. Jeddah, 25.3.69. Coded E. SOC during 1975.

53-414
C/N 95307 ff T.M.S. Ferguson 21.11.69. Jeddah, 25.3.69. Coded F. Crashed 10.4.71, on approach to airfield, three civilians killed, pilot died on way to hospital.

53-415
C/N 95308 ff P. Millet 12.2.69. Jeddah 23.5.69. Coded H.

53-416
C/N 95309 ff D. Eagles 25.2.69. Jeddah 11.7.69. Coded J. Stored in 1969.

53-417
C/N 95310 ff J.L. Dell 14.3.69. Jeddah 23.5.69. Coded K.

53-418
C/N 95311 ff D. Eagles 25.4.69. Paris Salon 1969 as G-AXEE and 512. To Jeddah 11.7.69. Coded L.

53-419
C/N 95312 ff P. Ginger 20.5.69. Jeddah 26.8.69. Coded M. Destroyed 2.8.71 at Rezayat, in take-off accident. 84.15 hours.

53-420
C/N 95313 ff P. Millet 8.5.69. To Kuwait International Airport 19.7.69 via Akrotiri, Turkey and Iran. Coded N. Written off in unspecified accident.

53-421
C/N 95314 ff P. Millet 18.6.69. To Kuwait International Airport 19.7.69 via Akrotiri, Turkey and Iran. Coded O.

53-422
C/N 95315 ff J. Cockburn 18.8.69. Jeddah 4.12.69 via Akrotiri. Coded P.

53-423
C/N 95316 ff J. Cockburn 11.9.69. Jeddah 3.12.69 via Akrotiri. Coded R.

T.Mk.55 (Saudi Arabia)

55-710
C/N 95020 (XS460). ff 2.2.66. Crashed on landing at Warton in strong cross winds. 14.53 hours.

55-711
C/N 95024 ff R.P. Beamont 29.8.67. To Coltishall for Saudi pilot training 2.2.68 coded A later 203. To Saudi Arabia 27.8.69 for Lightning Conversion Unit at Dhahran. LCU, 6 Squadron, 13 Squadron (1315), 2 Squadron (234). 14.1.86 returned to Warton as ZF597. 2484.48 hours. To Portsmouth Marine Salvage.

55-712
C/N 95025 ff T.M.S. Ferguson 12.10.67. Aircraft used to fly Japanese delegation at Warton 29.11.67. To Coltishall for Saudi pilot training, coded B later 207, 15.2.68. To Saudi Arabia 11.7.69. LCU, 6 Squadron. Crashed into Half Moon Bay 21.5.74.

55-713
C/N 95026 ff R.P. Beamont 16.11.67. To Coltishall for Saudi pilot training, coded C later 206, 2.2.68. To Saudi Arabia via Akrotiri 27.8.69. LCU, 6 Squadron, 13 Squadron (1316), 2 Squadron (235). 14.1.86 returned to Warton from Tabuk as ZF598. 2233.30 hours. To Midlands Air Museum, Coventry.

55-714
C/N 95027 ff R.P. Beamont and P. Millet 1.2.68. To Coltishall for Saudi pilot training, coded D later 212, 23.3.68. To Saudi via Akrotiri, 11.7.69. LCU, 6 Squadron, 13 Squadron (1317), 2 Squadron (231). 22.1.86 returned to Warton as ZF595. 2370.6 hours. To Portsmouth Marine Salvage.

55-715
C/N 95028 ff J. Cockburn and R.T. Stock 28.2.68. To Saudi Arabia 11.3.69. LCU, 6 Squadron (305), 2 Squadron (220 later233). 22.1.86 returned to Warton as ZF596. 2053.12 hours. To Portsmouth Marine Salvage.

55-716
C/N 95030 ff T.M.S. Ferguson 14.7.69. Replacement for 55-710 which crashed prior to delivery. To Saudi Arabia 30.9.69. LCU (E), 2 Squadron (219 later 230). WFU 7.84. Scrapped 1985.

T.Mk.55K (Kuwait)

55-410
C/N 95023 ff 24.5.68. Delivered to Kuwait 18.12.68. Coded A. WFU 1977 Ali Al Salem AB. Destroyed by Iraqi AF raid during invasion of Kuwait.

55-411
C/N 95024 ff 3.4.69. Delivered to Kuwait 3.12.69. Coded B. WFU 1977. Last recorded sighting at Messila Beach Club, Kuwait.

DB aircraft XG325 was assigned to de Havilland at Hatfield for Firestreak and Red Top missile trials. The aircraft is pictured carrying two Red Tops.
(Photo: British Aerospace)

Technical Data

P.1A
Weight empty 20,021lb
Weight with full load 28,261lb
Span 34ft 10in
Length 49ft 8in
Height 17ft 3in
Wing area 458.5 sq ft
Powerplant 2 x Armstrong Siddeley Sapphire 5 rated at 7,500lb
2 x Armstrong Siddeley Sapphire 5R rated at 9,200lb (with reheat)
Max speed Mach 1.53 at 36,000ft
Ceiling 55,000ft

P.1B
Weight empty 24,816lb
Weight with full load 31,831lb, max loaded 34,140lb
Span 34ft 10in
Length 55ft 3in
Height 19ft 5in
Wing area 458.5 sq ft
Powerplant 2 x Rolls Royce Avon 209 rated at 14,430lb
Max speed Mach 1.7 at 40,000ft
Ceiling 55,000ft

Lightning F.Mk.1
Weight empty 25,753lb
Max weight 35,000lb
Span 34ft 10in
Length 55ft 3in
Height 19ft 7in
Wing area 458.5 sq ft
Powerplant 2 x Rolls Royce Avon 210 rated at 14,430lb
Max speed Mach 2.1 at 40,000ft
Ceiling 60,000ft

Lightning F.Mk.1A
Weight empty 25,737lb
Max weight 35,000lb
Span 34ft 10in
Length 55ft 3in
Height 19ft 7in
Wing area 458.5 sq ft
Powerplant 2 x Rolls Royce Avon 210 rated at 14,430lb
Max speed Mach 1.7 at 40,000ft
Ceiling 60,000ft

Lightning F.Mk.2
Weight empty 27,000lb
Max weight 34,500lb
Span 34ft 10in
Length 55ft 3in
Height 19ft 7in
Wing area 458.5 sq ft
Powerplant 2 x Rolls Royce Avon 210 rated at 14,430lb
Max speed Mach 1.7 at 40,000ft
Ceiling 60,000ft

Lightning F.Mk.2A
Weight empty 27,500lb
Max weight 39,750lb
Span 34ft 10in
Length 55ft 3in
Height 19ft 7in
Wing area 474.5 sq ft
Powerplant 2 x Rolls Royce Avon 211 rated at 14,430lb
Max speed Mach 1.7 at 40,000ft
Ceiling 60,000ft

Lightning F.Mk.3
Weight empty 26,905lb
Max weight 35,500lb
Span 34ft 10in
Length 55ft 3in
Height 19ft 7in
Wing area 458.5 sq ft
Powerplant 2 x Rolls Royce Avon 301 rated at 16,360lb
Max speed Mach 2.0 at 40,000ft
Ceiling 60,000ft

Lightning F.Mk.6
Weight empty 28,041lb
Weight with full load 41,700lb
Span 34ft 10in
Length 55ft 3in
Height 19ft 7in
Wing area 474.5 sq ft
Powerplant 2 x Rolls Royce Avon 302 rated at 16,360lb
Max speed Mach 2.0 at 40,000ft
Ceiling 65,000ft

Lightning F.Mk.53
Weight empty 28,041lb
Weight with full load 41,700lb
Span 34ft 10in
Length 55ft 3in
Height 19ft 7in
Wing area 474.5 sq ft
Powerplant 2 x Rolls Royce Avon 302C rated at 16,360lb
Max speed Mach 2.0 at 40,000ft
Ceiling 65,000ft

Lightning T.Mk.4
Weight empty 27,000lb
Max weight 35,000lb
Span 34ft 10in
Length 55ft 3in
Height 19ft 7in
Wing area 458.5 sq ft
Powerplant 2 x Rolls Royce Avon 210 rated at 14,430lb
Max speed Mach 1.7 at 40,000ft
Ceiling 60,000ft

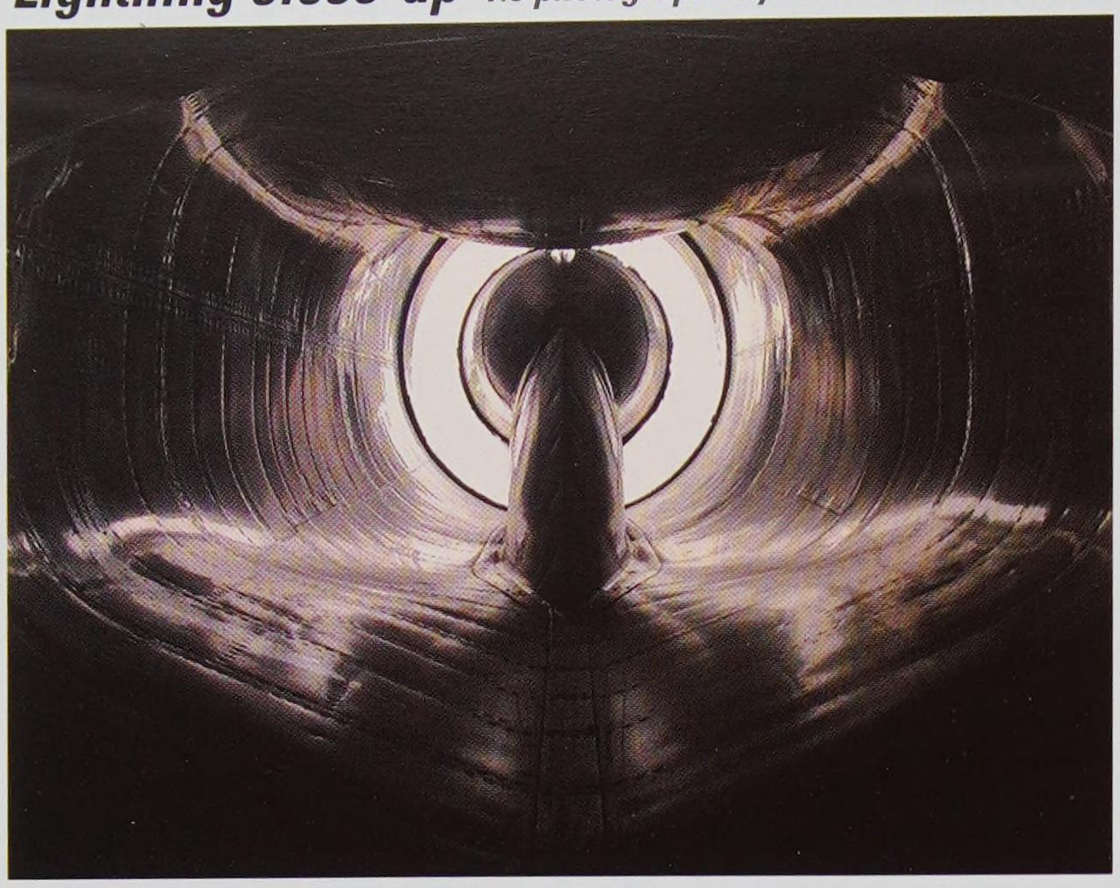
Lightning T.Mk.5
Weight empty 27,000lb
Weight with full load 41,700lb
Span 34ft 10in
Length 55ft 3in
Height 19ft 7in
Wing area 474.5 sq ft
Powerplant 2 x Rolls Royce Avon 302 rated at 16,360lb
Max speed Mach 2.0 at 40,000ft
Ceiling 60,000ft

Lightning T.Mk.55
Weight empty 27,000lb
Weight with full load 41,700lb
Span 34ft 10in
Length 55ft 3in
Height 19ft 7in
Wing area 474.5 sq ft
Powerplant 2 x Rolls Royce Avon 302C rated at 16,360lb
Max speed Mach 2.0 at 40,000ft
Ceiling 60,000ft

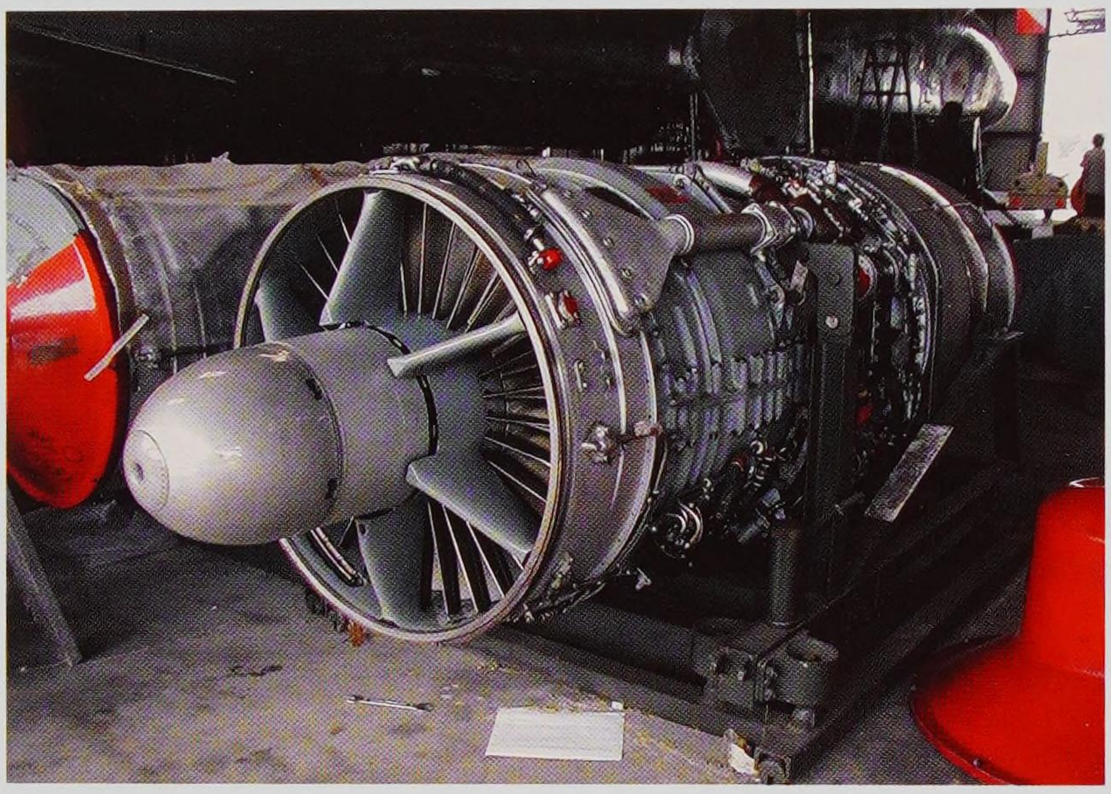
NB Aircraft weight specifications are general figures which varied depending upon equipment fitted to individual aircraft.

Performance figures also varied. The accepted maximum speed attained by the Lightning was Mach 2.1-Mach 2.2 and maximum ceiling was around 85,000ft although these figures were obviously achieved or attempted only rarely and were not routinely accepted for operational flying.

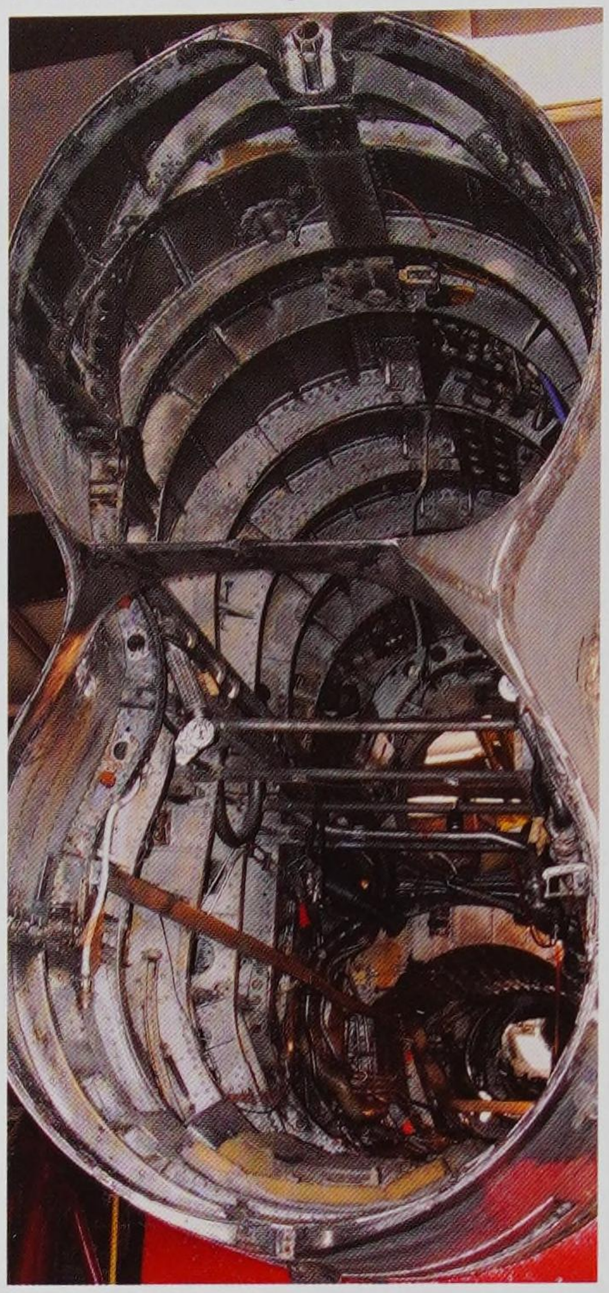
Lightning close-up *F.6 photographs by Tim McLelland and John Davidson, T.5 images courtesy of AALO*



The view from inside the Lightning's intake looking outwards, illustrating the supporting structure for the central shock cone, into which the nose undercarriage retracted. The upper surfaces of the intake are bulged inwards and downwards to accommodate the cockpit area. (Photo: John Davidson)

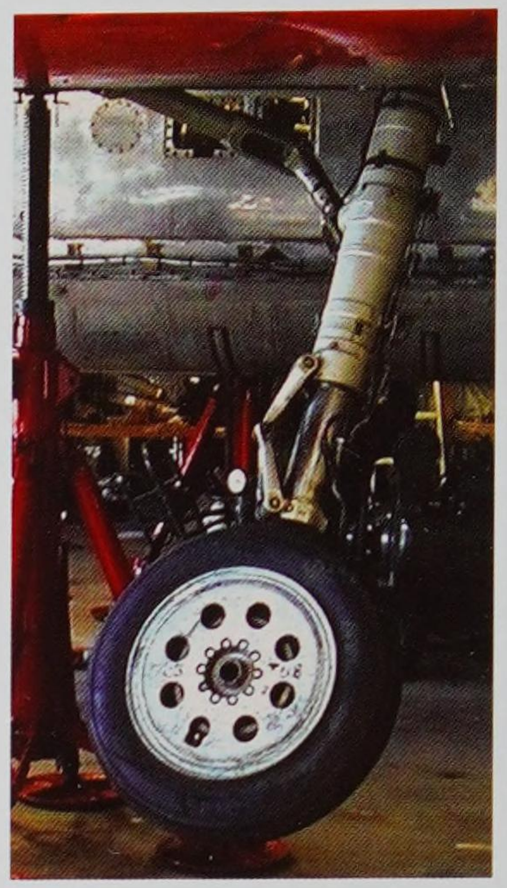


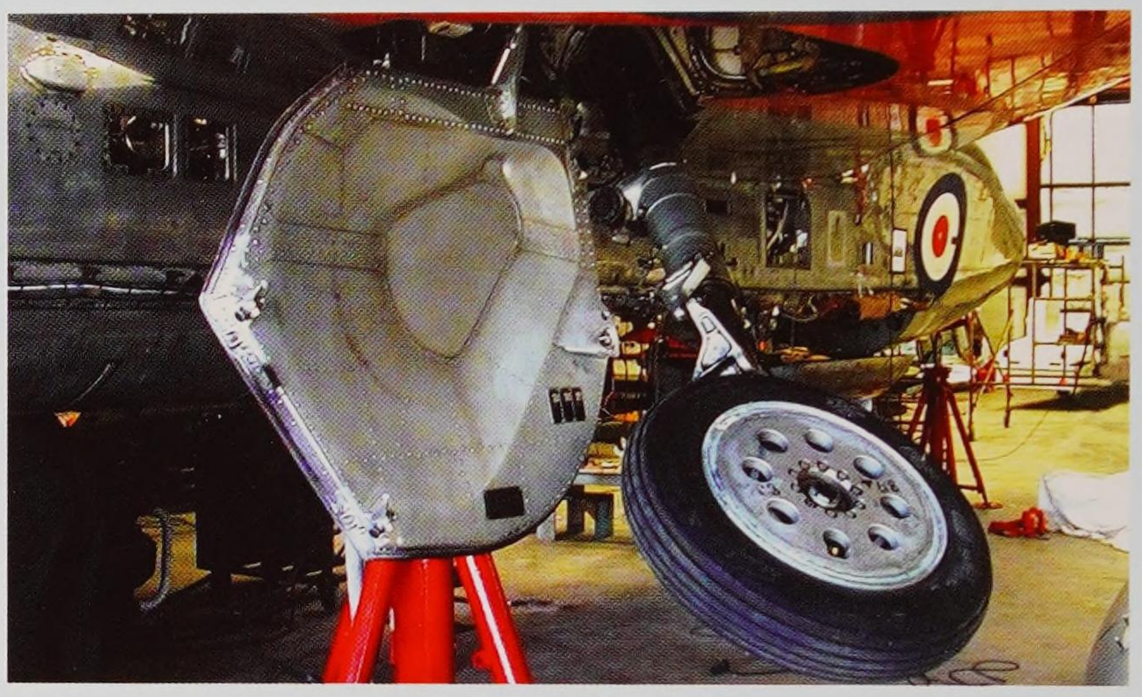
One of XS422's mighty Avon engines awaiting refitting into the aircraft. (Photo: AALO)



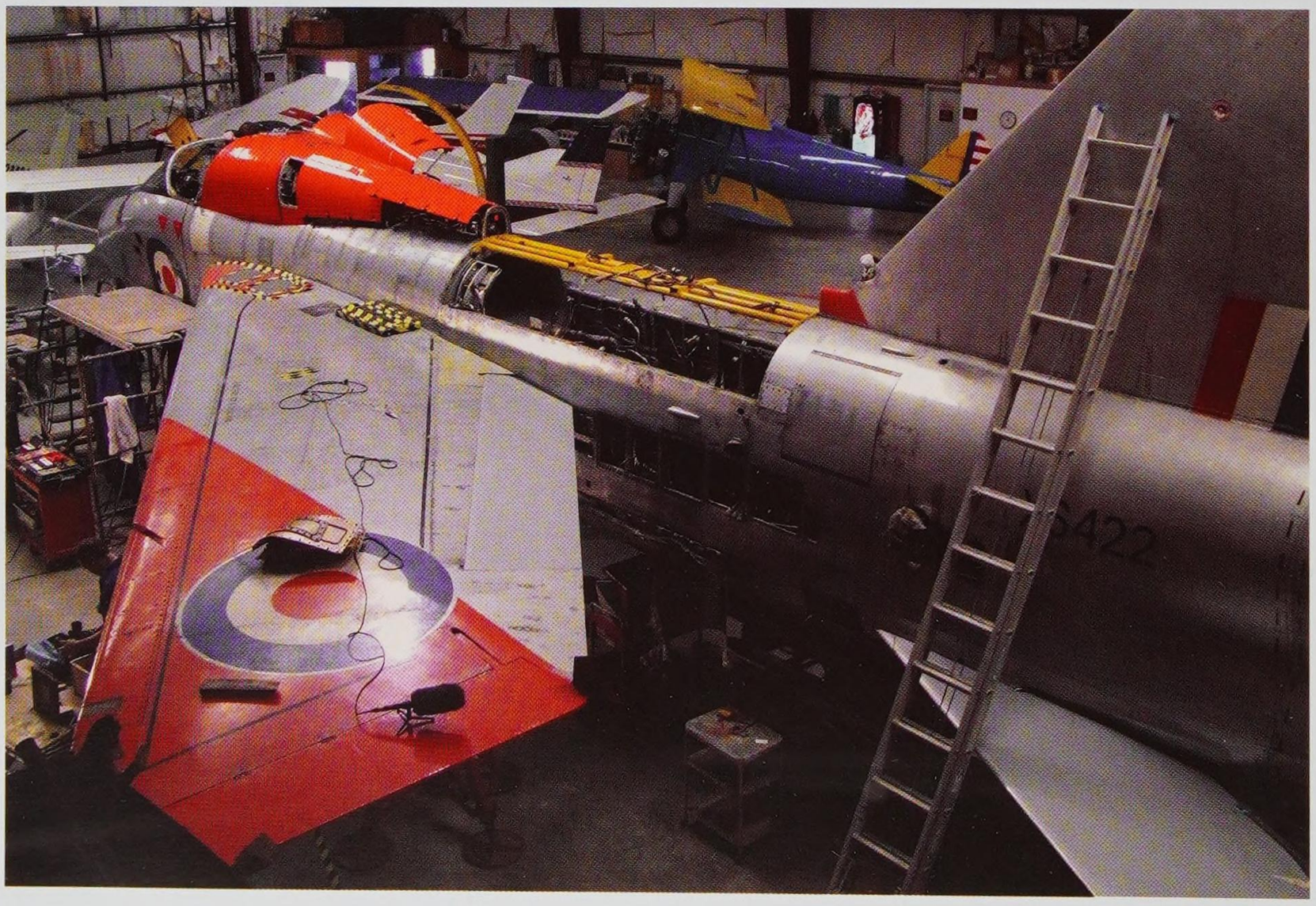
Rear fuselage engine bays with the power plants removed. (Photo: AALO)

Main gear captured during the retraction sequence, showing the main leg's outward and rearwards - hinged movement and the support brace hinge. (Photo: AALO)



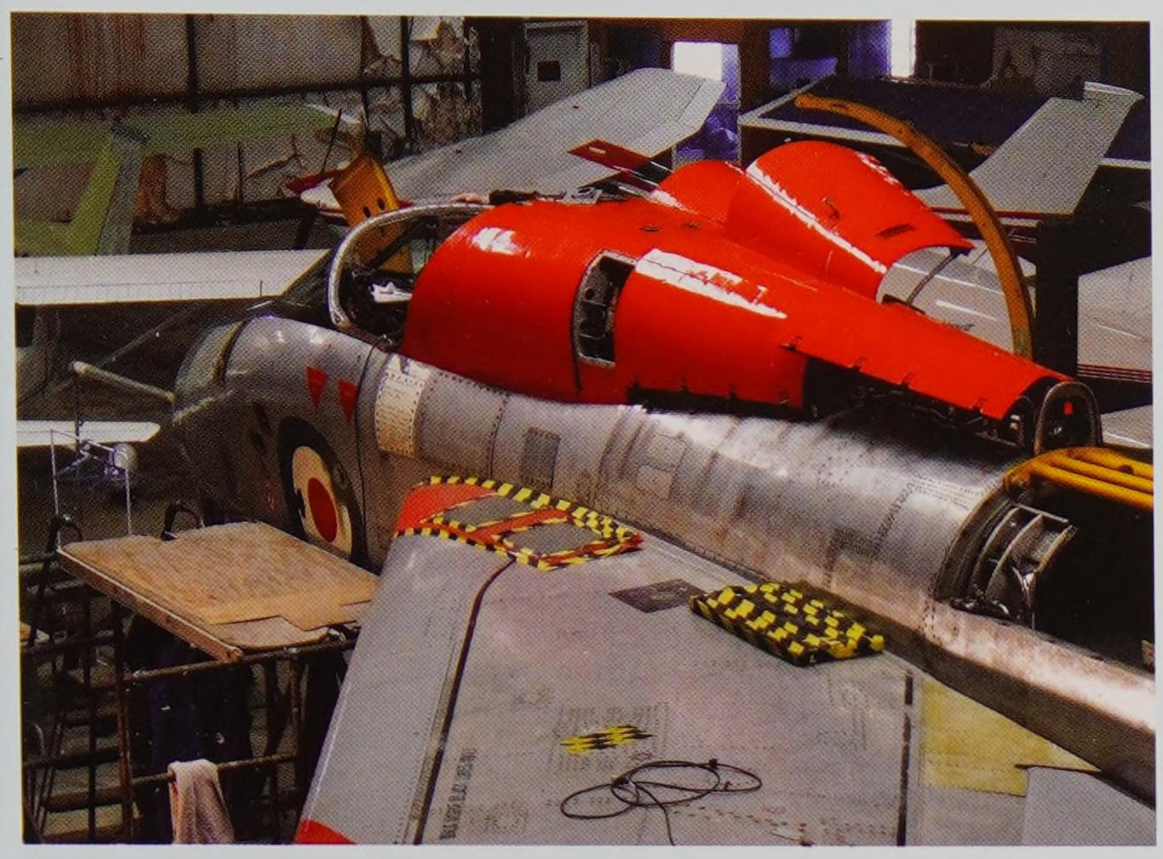


Starboard main gear retracting into the wheel bay. (Photo: AALO)



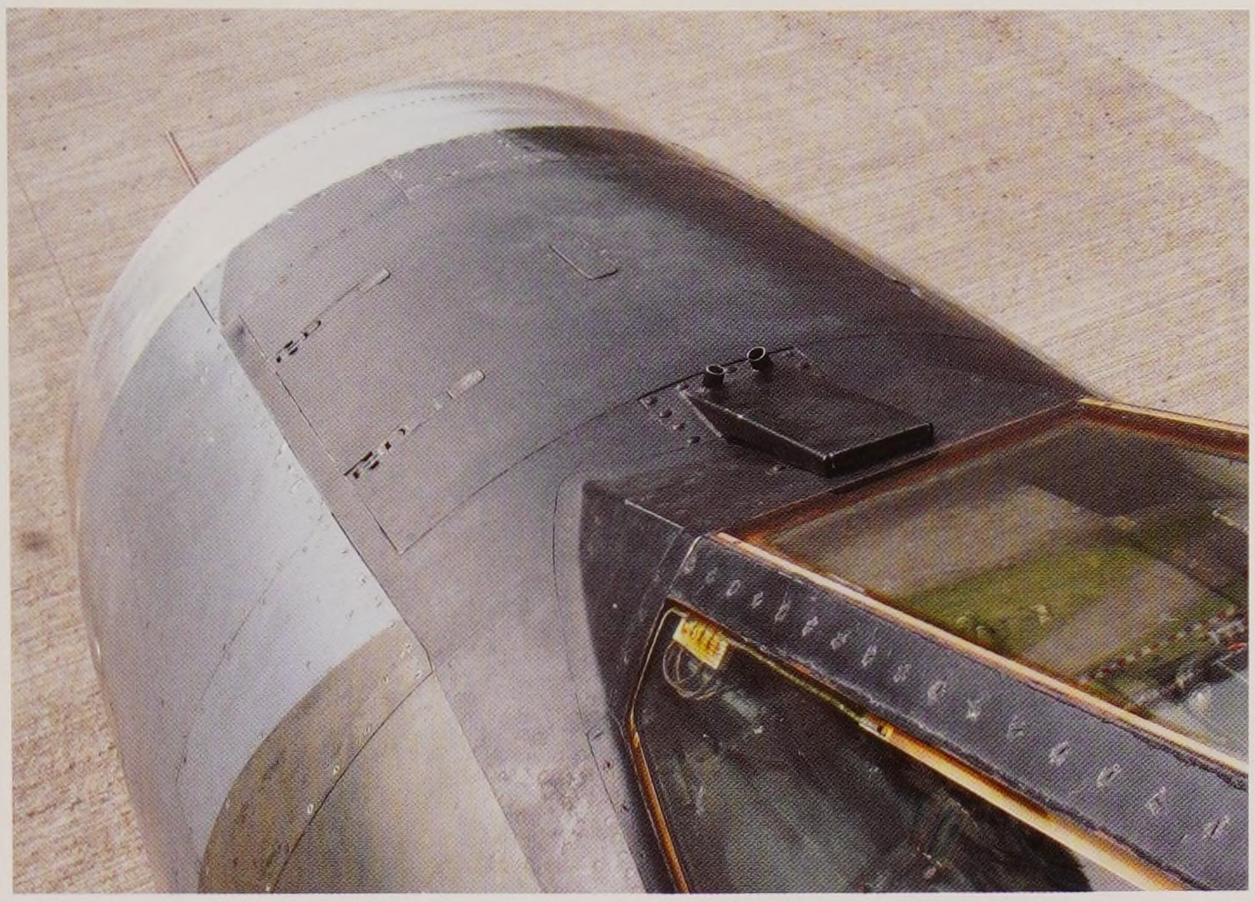
The photographs on this page and immediately opposite show Lightning T.5, XS244 under restoration to fly at Stennis in the US.

XS244 at Stennis. This view clearly illustrates the early "straight wing" aileron and leading edge notch position. (Photo: AALO)



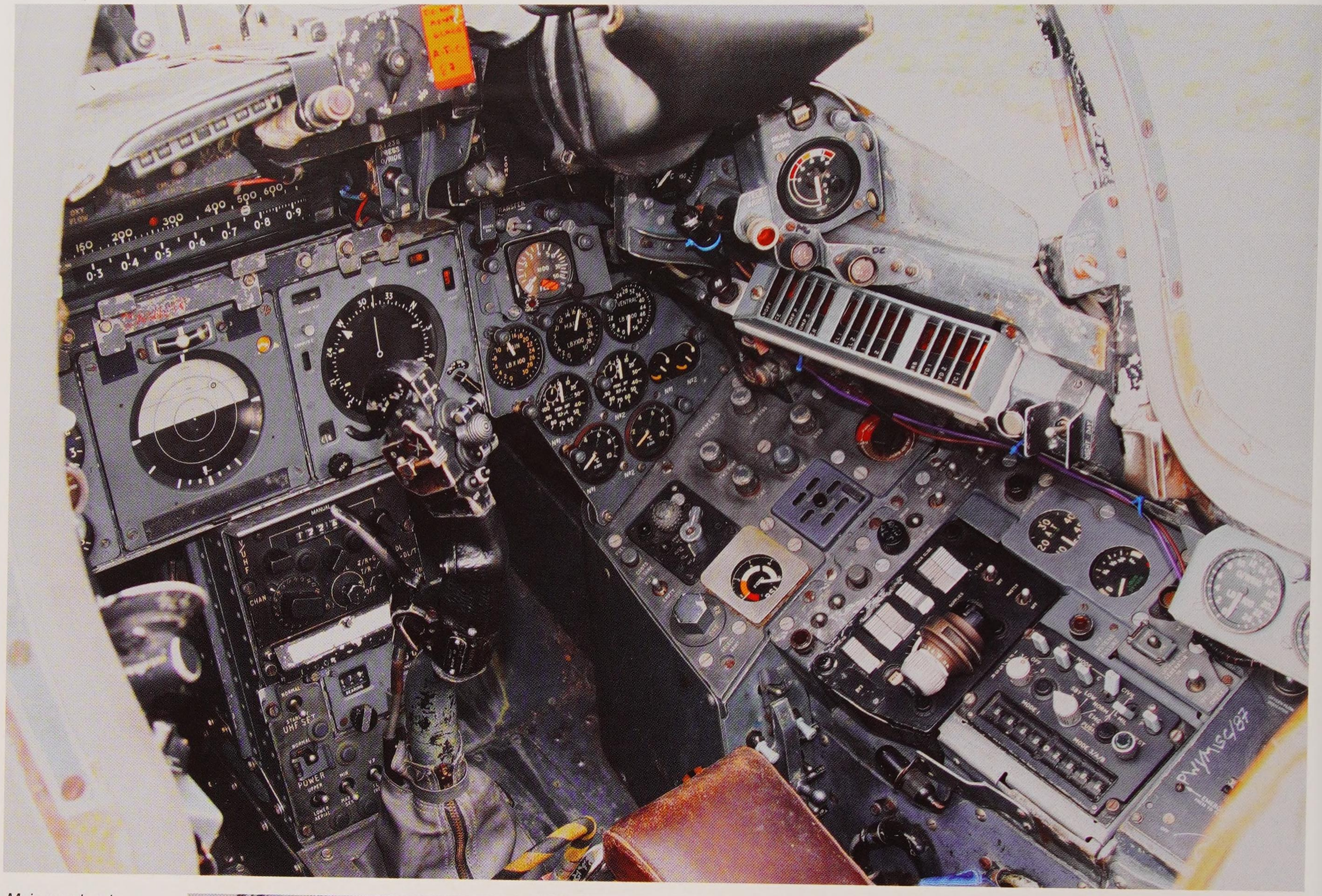
Close-up look at the T.5's upper fuselage, illustrating the spine fairing which has been partially detached for access. (Photo: AALO)

Inside XS422's engine bay, illustrating the beautiful restoration job which has been performed on this complex aircraft. (Photo: AALO)

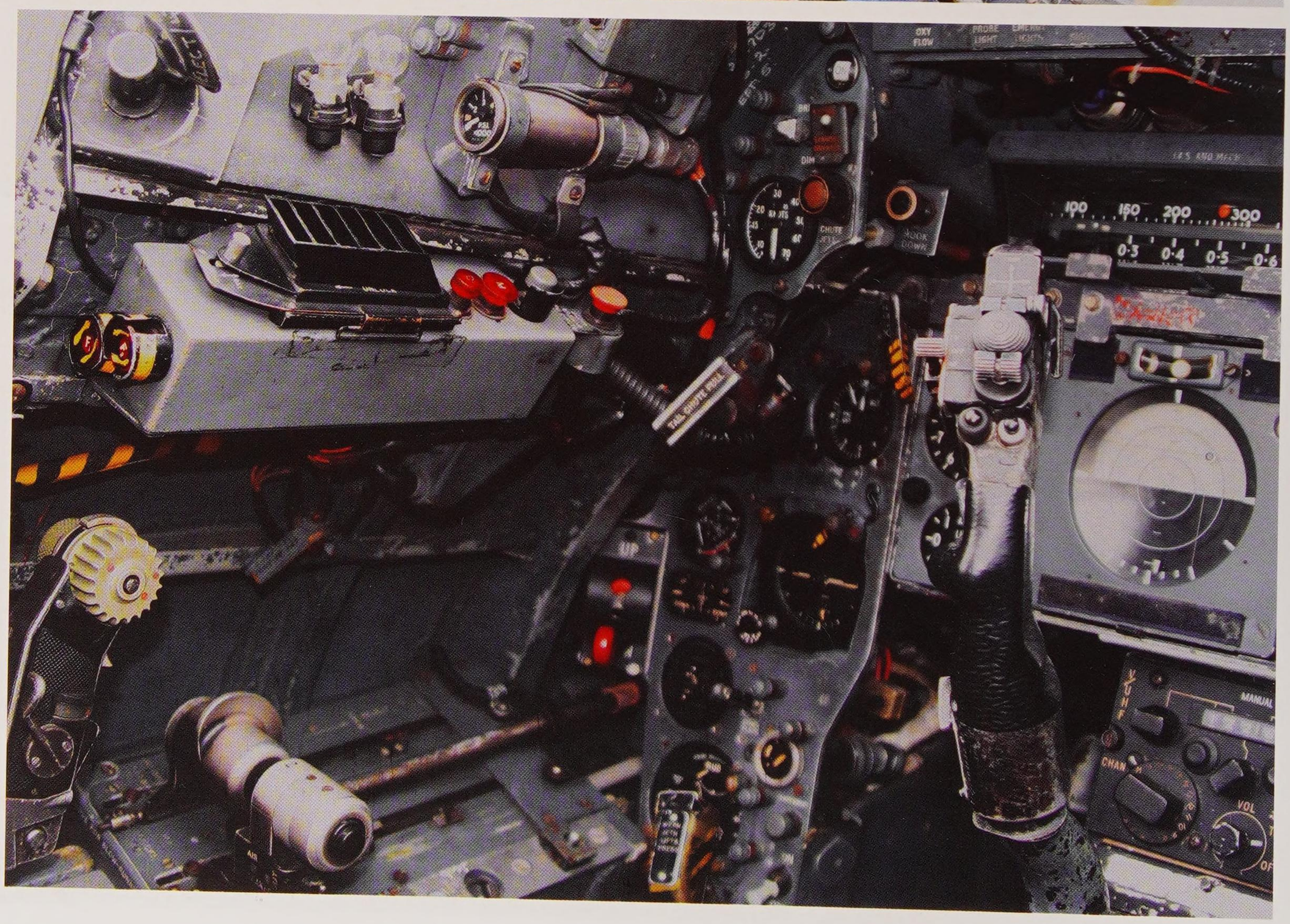


Nose and windscreen. The square shaped object at the base of the windscreen is a nozzle for rain dispersal.

Upper main panel.

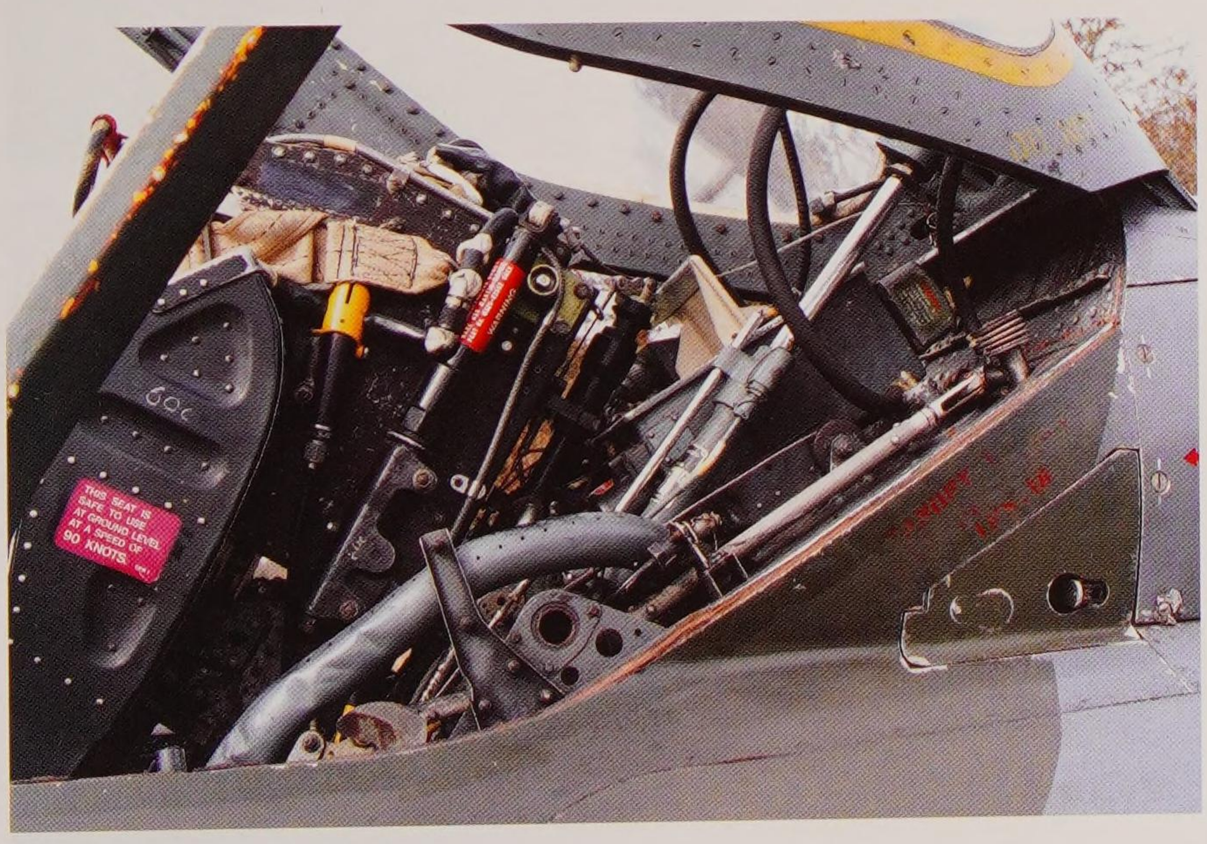


Main panel and starboard side.



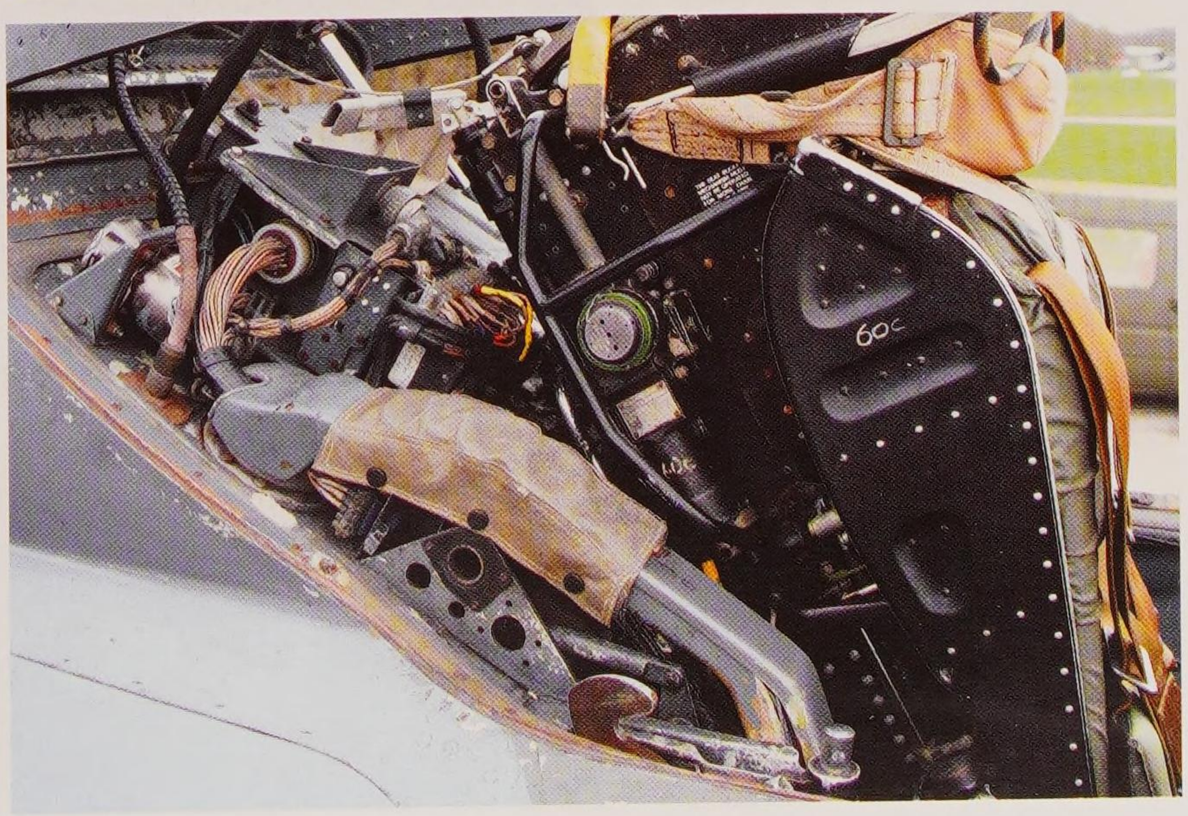
Port side and throttles.

Martin Baker ejection seat – port side.

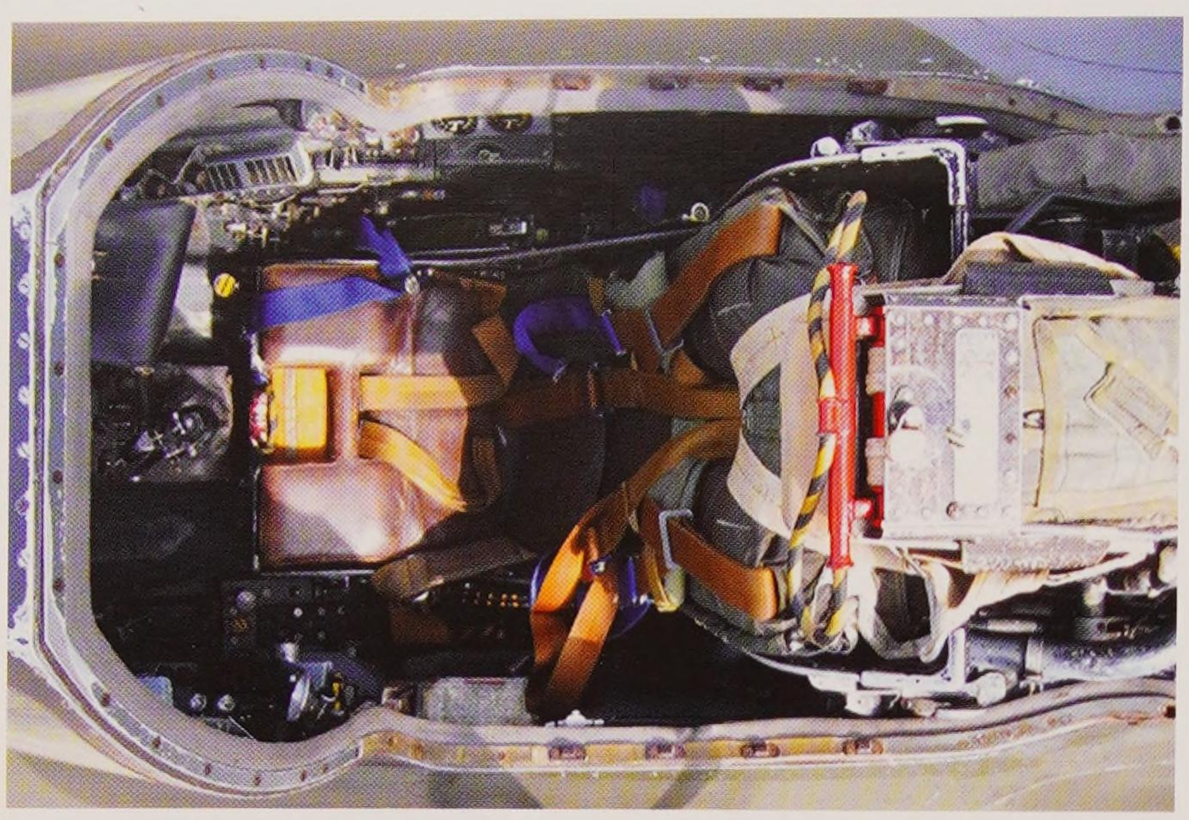


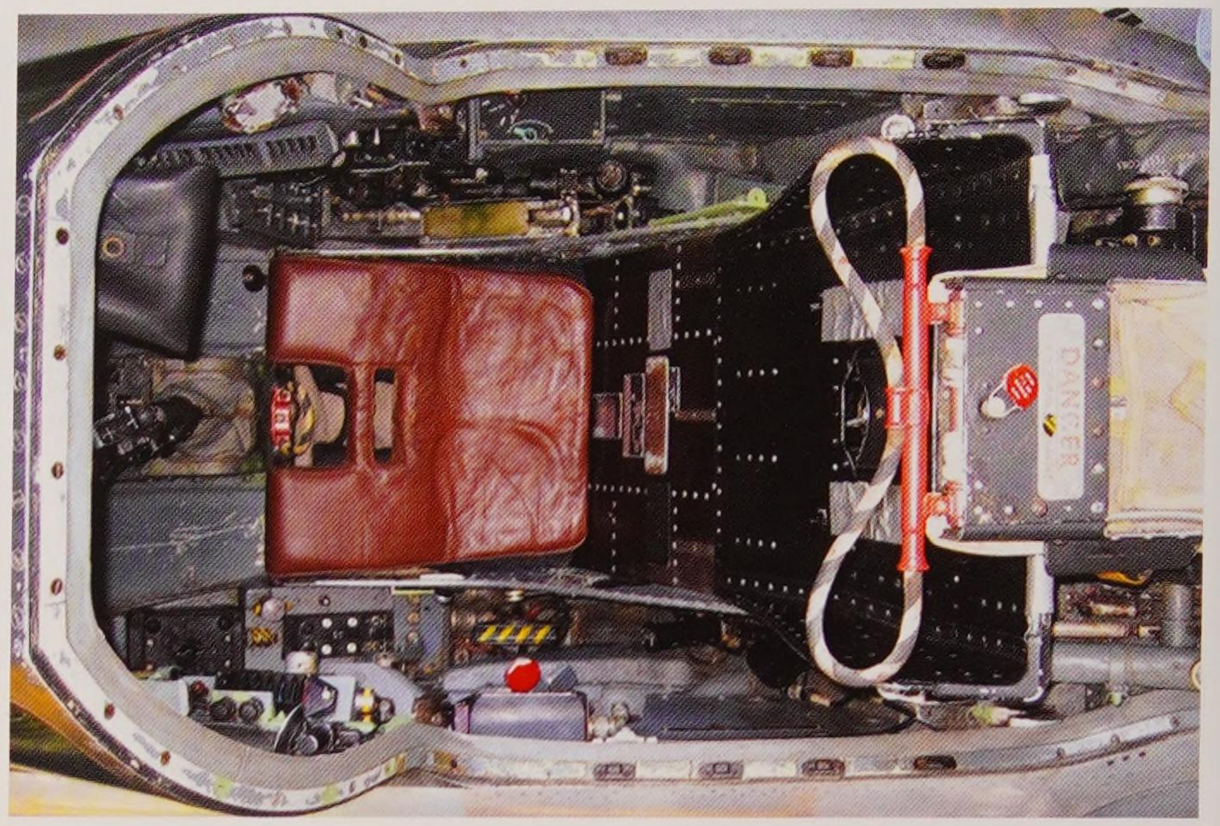
Above: Rear of cockpit port side.

Canopy rear – interior.

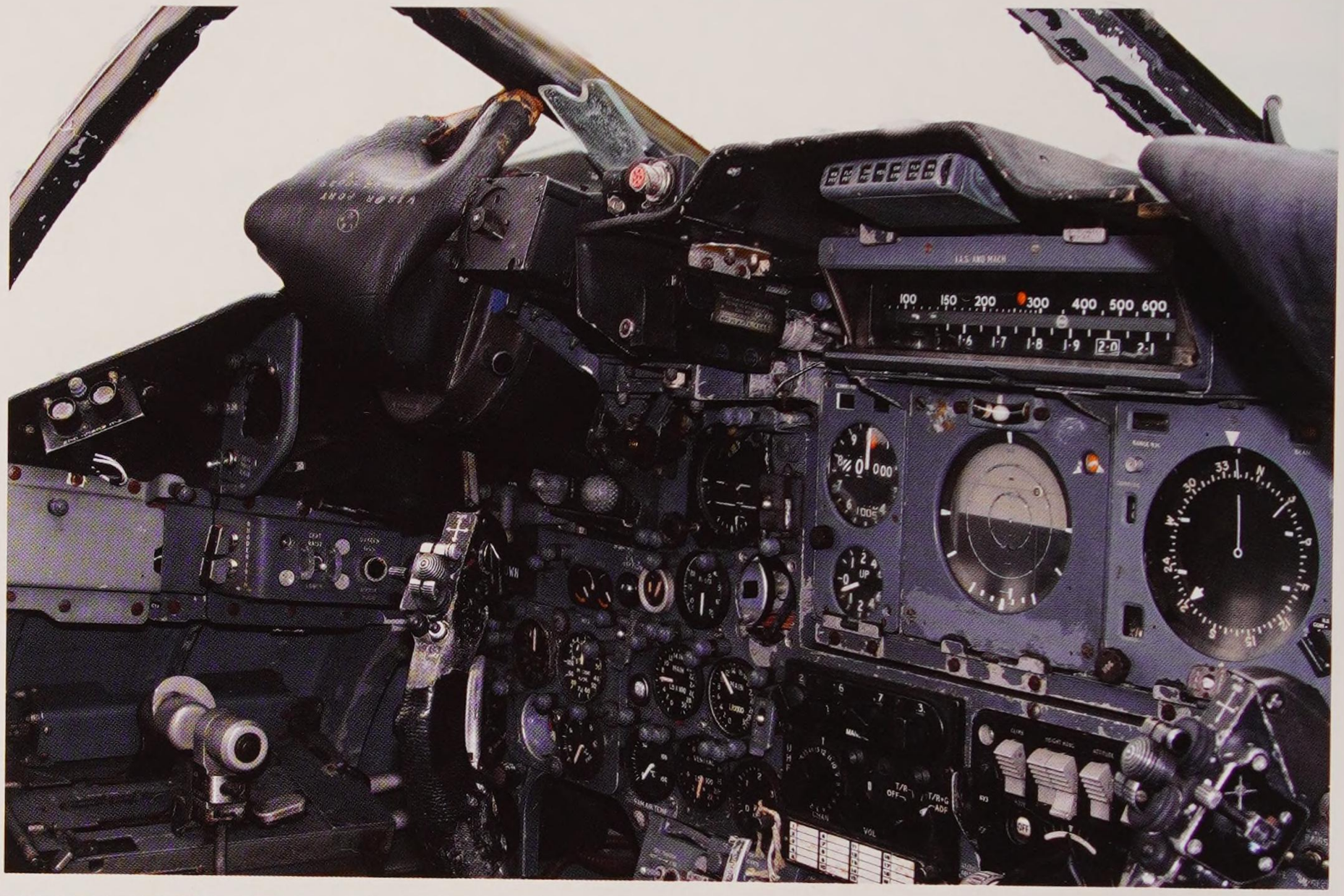


Right: Rear of cockpit starboard side.

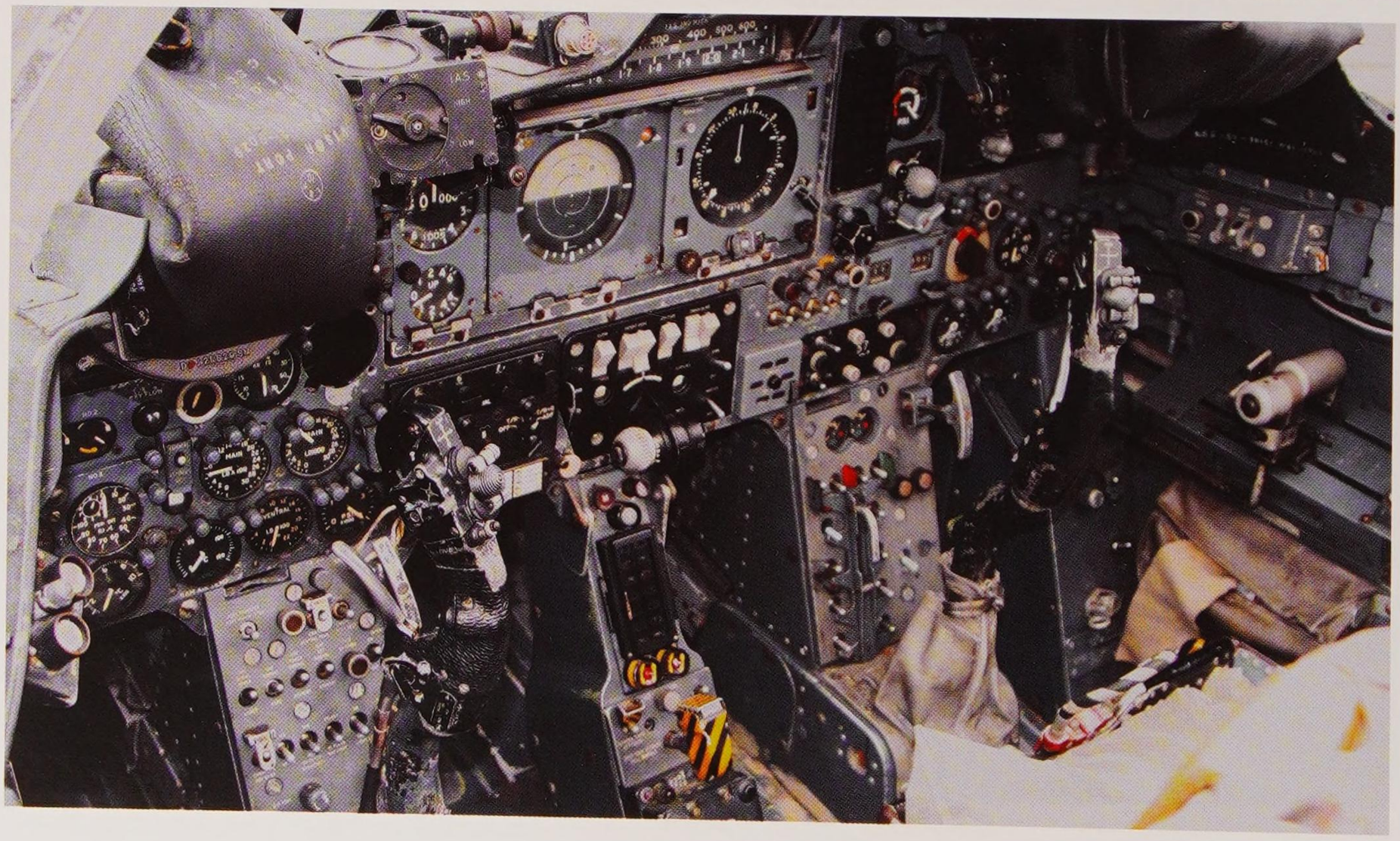




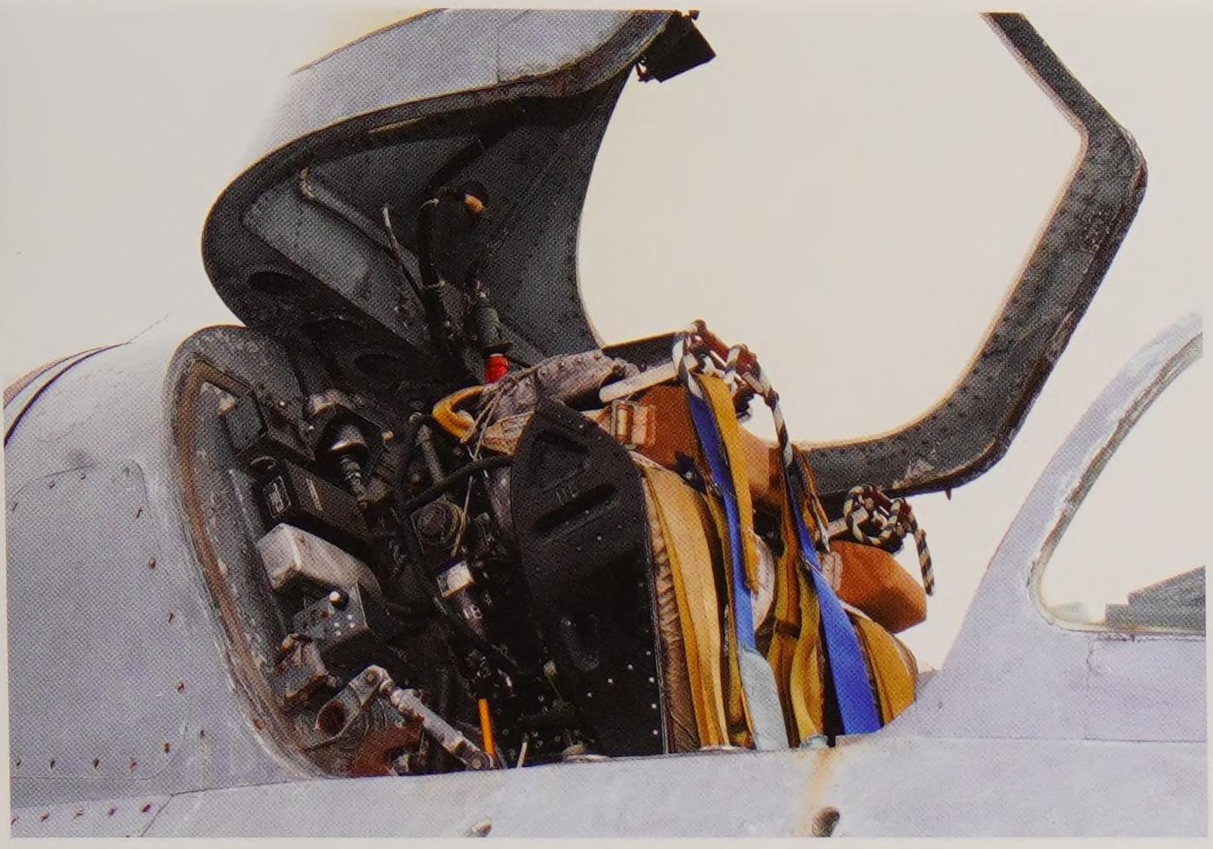
Above and above right: Vertical view into the cockpit of an F.6, showing the Martin Baker ejection seat, with and without the harness and parachute.



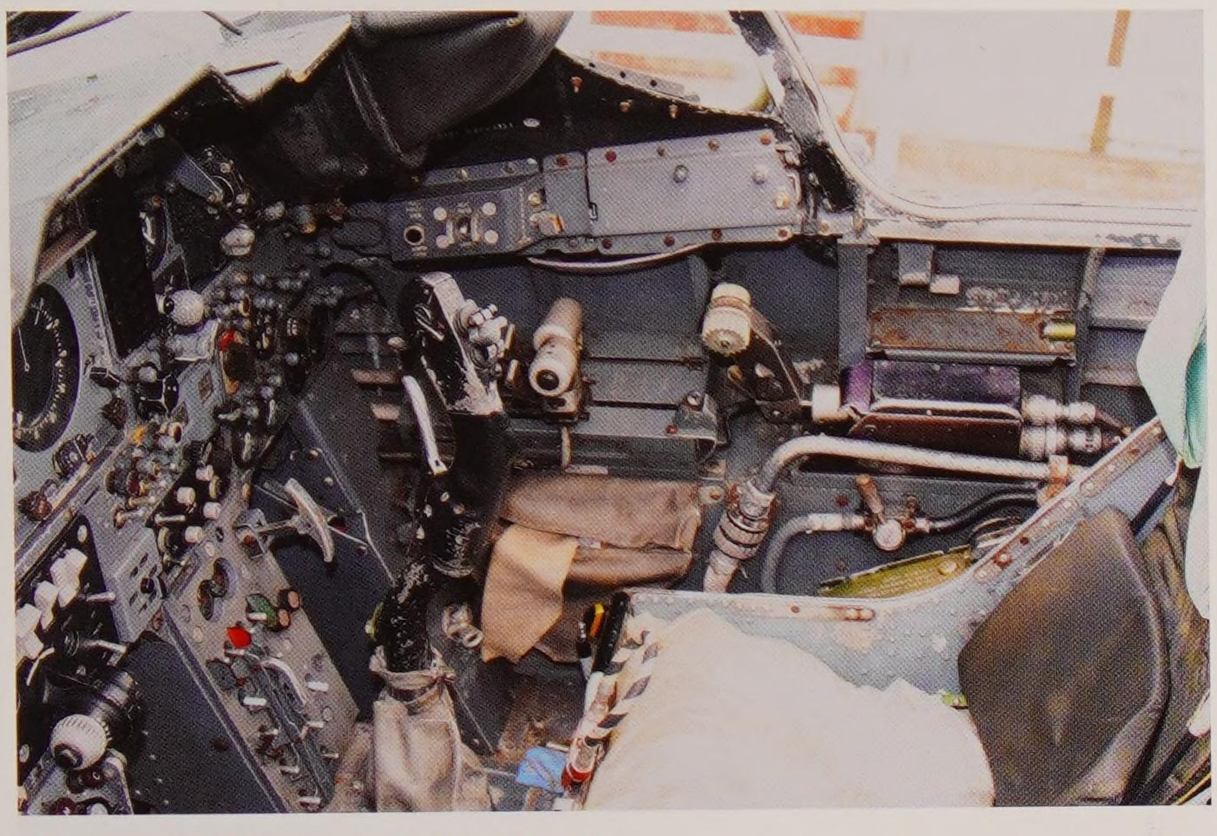
Above: main panel, port side and windshield of a T.5.



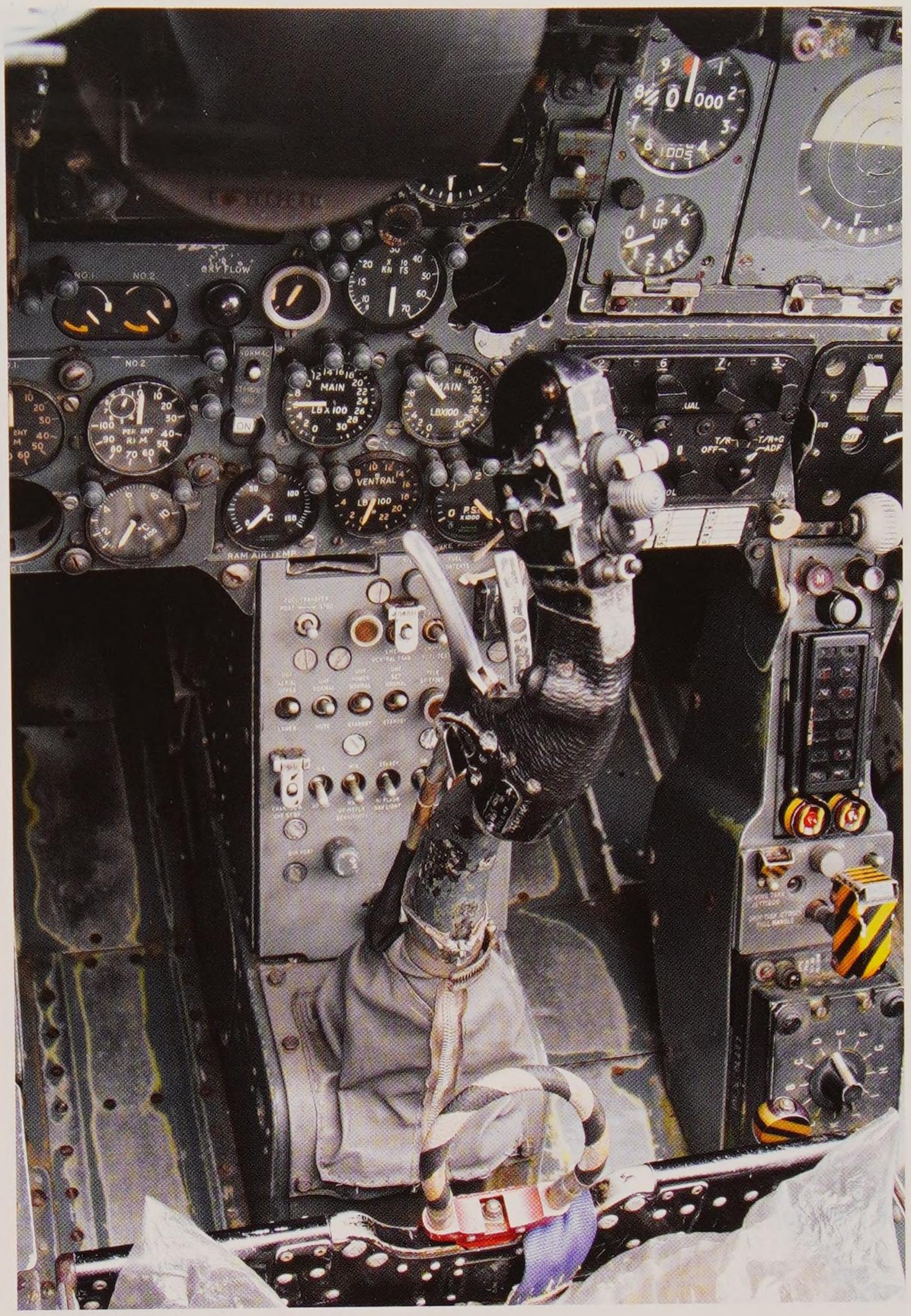
Above: main panel and starboard side of a T.5.



T.5 canopy.



T.5 starboard side, showing seat and throttles.



T.5 centre main panel.

T.5 windshield. The square-shaped object, at the base of the port windscreen, is a nozzle for rain dispersal.

This page: Red Top missile.

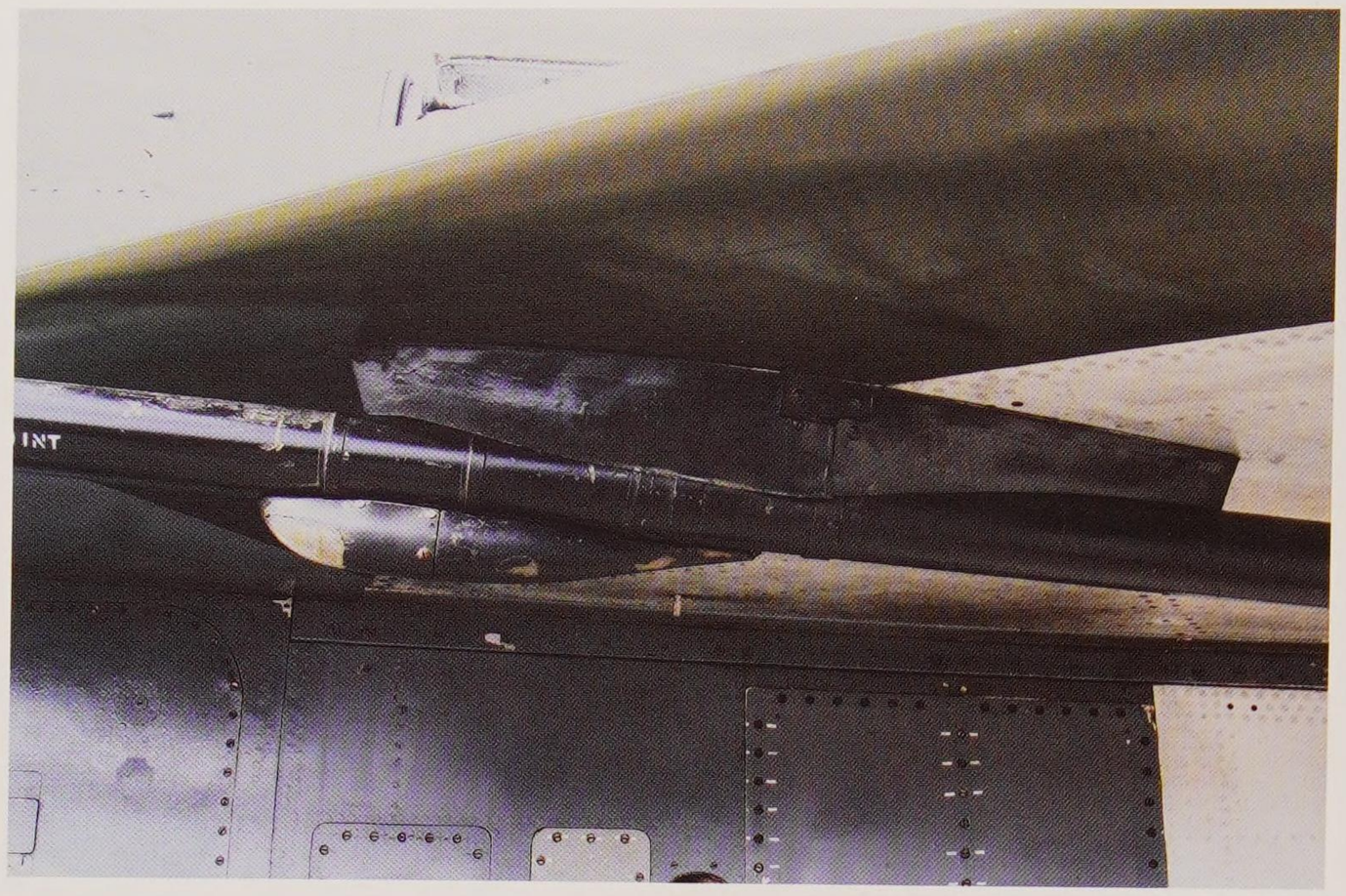
This page: Firestreak missile.

Port wing and leading edge.

Starboard wing leading edge notch.

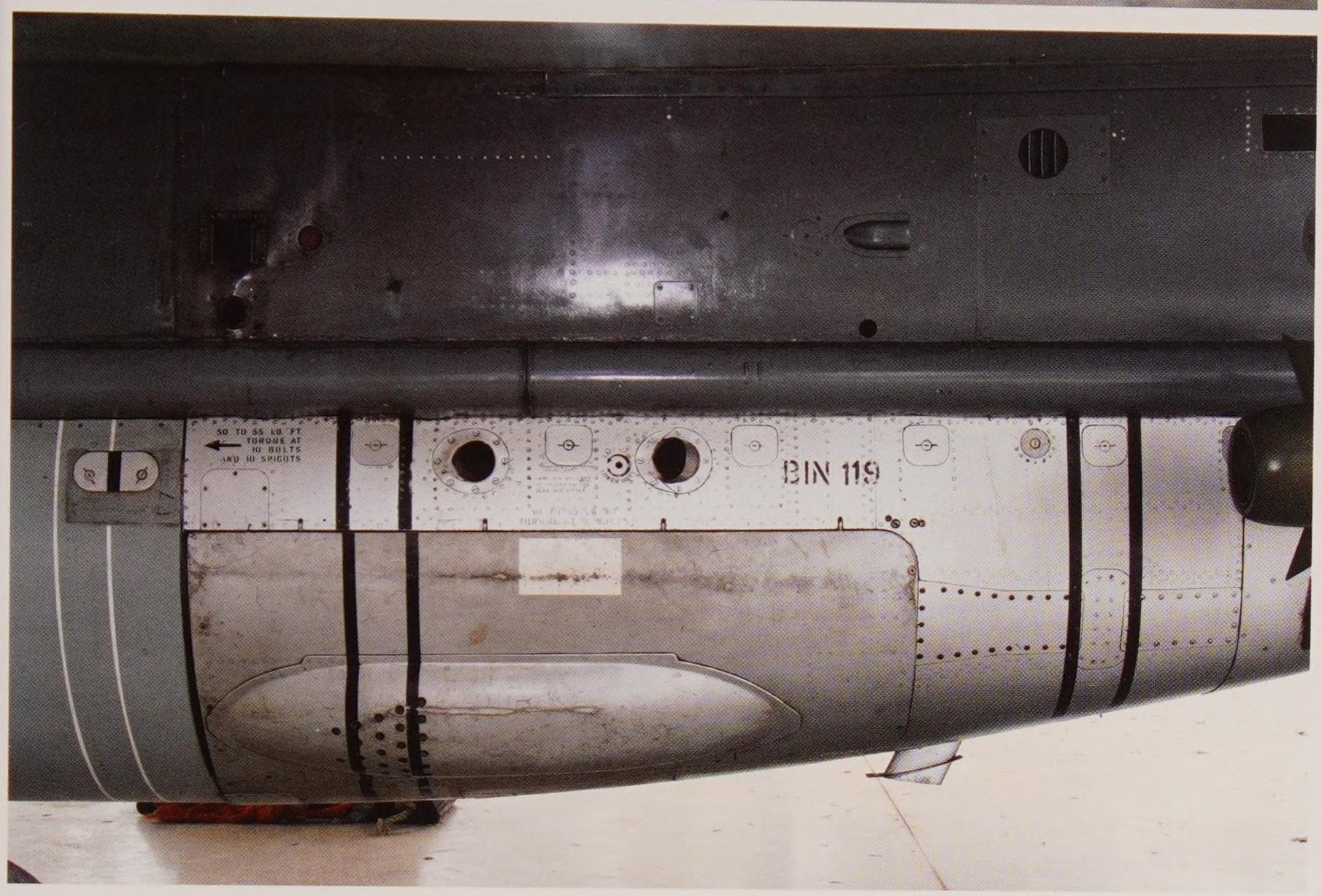
Port aileron.

Wing leading edge contours.



This page: Refuelling probe.

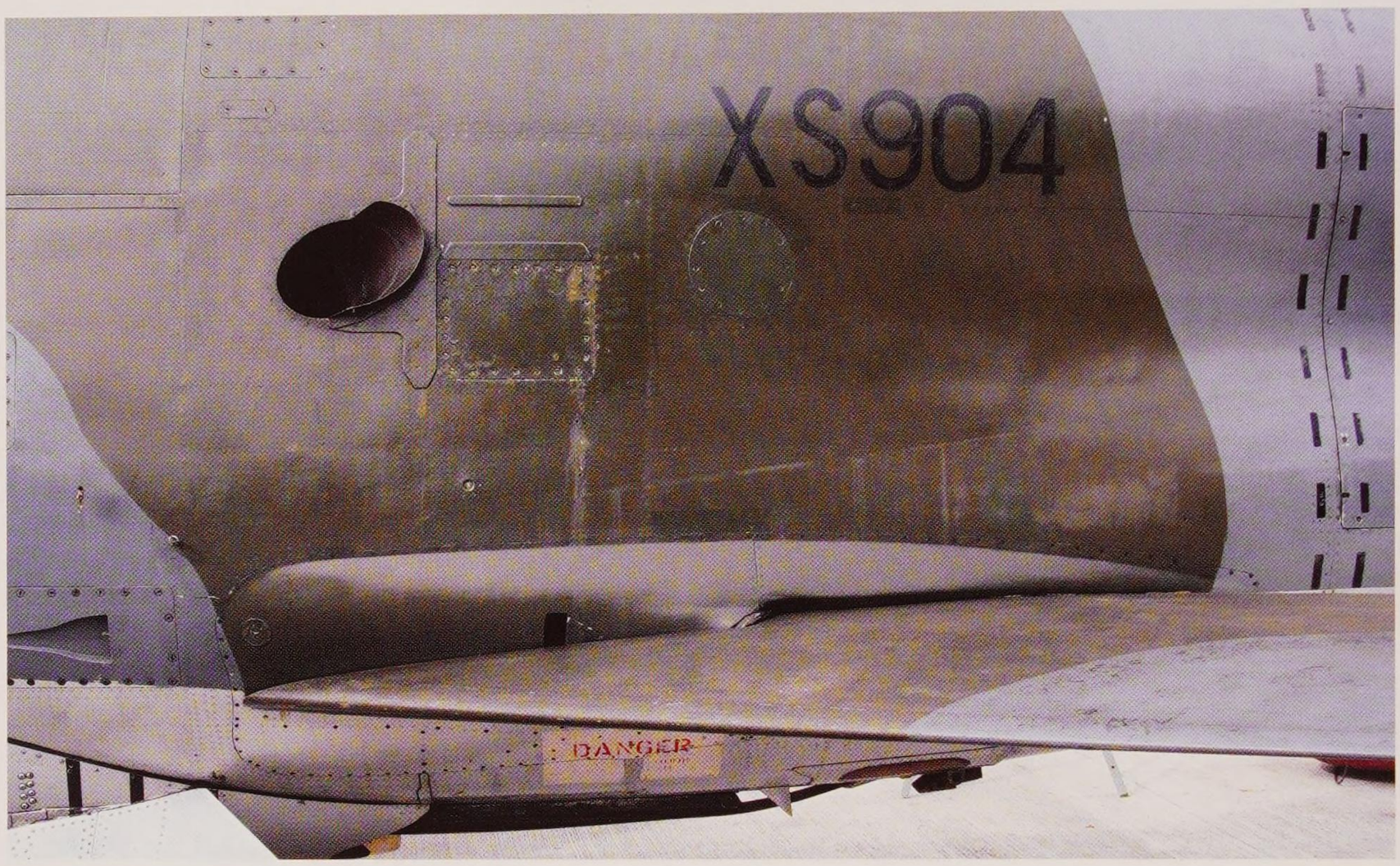
Port cannon blister.



Starboard cannon blister.

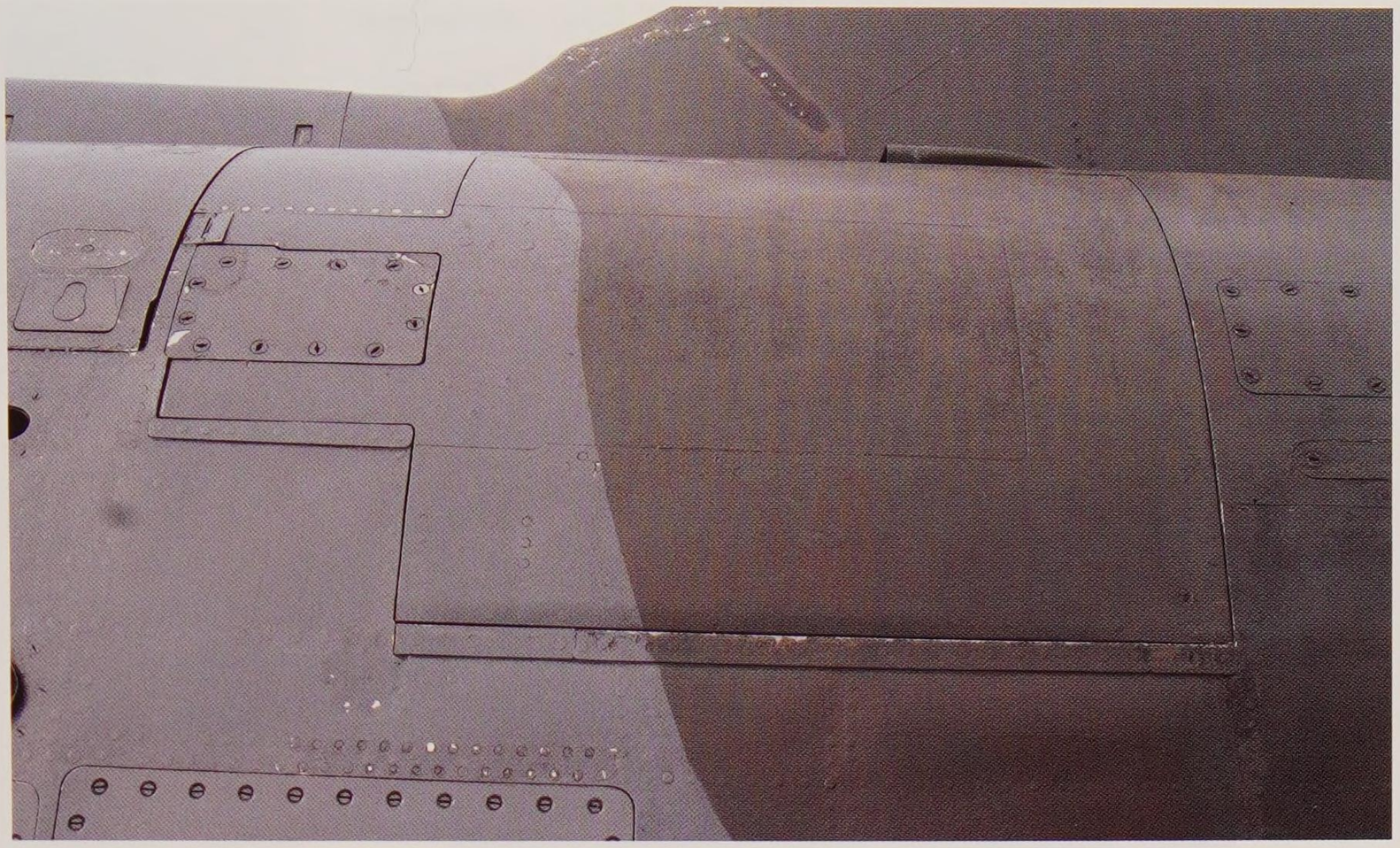
Starboard cannon muzzle.

Starboard rear fuselage.

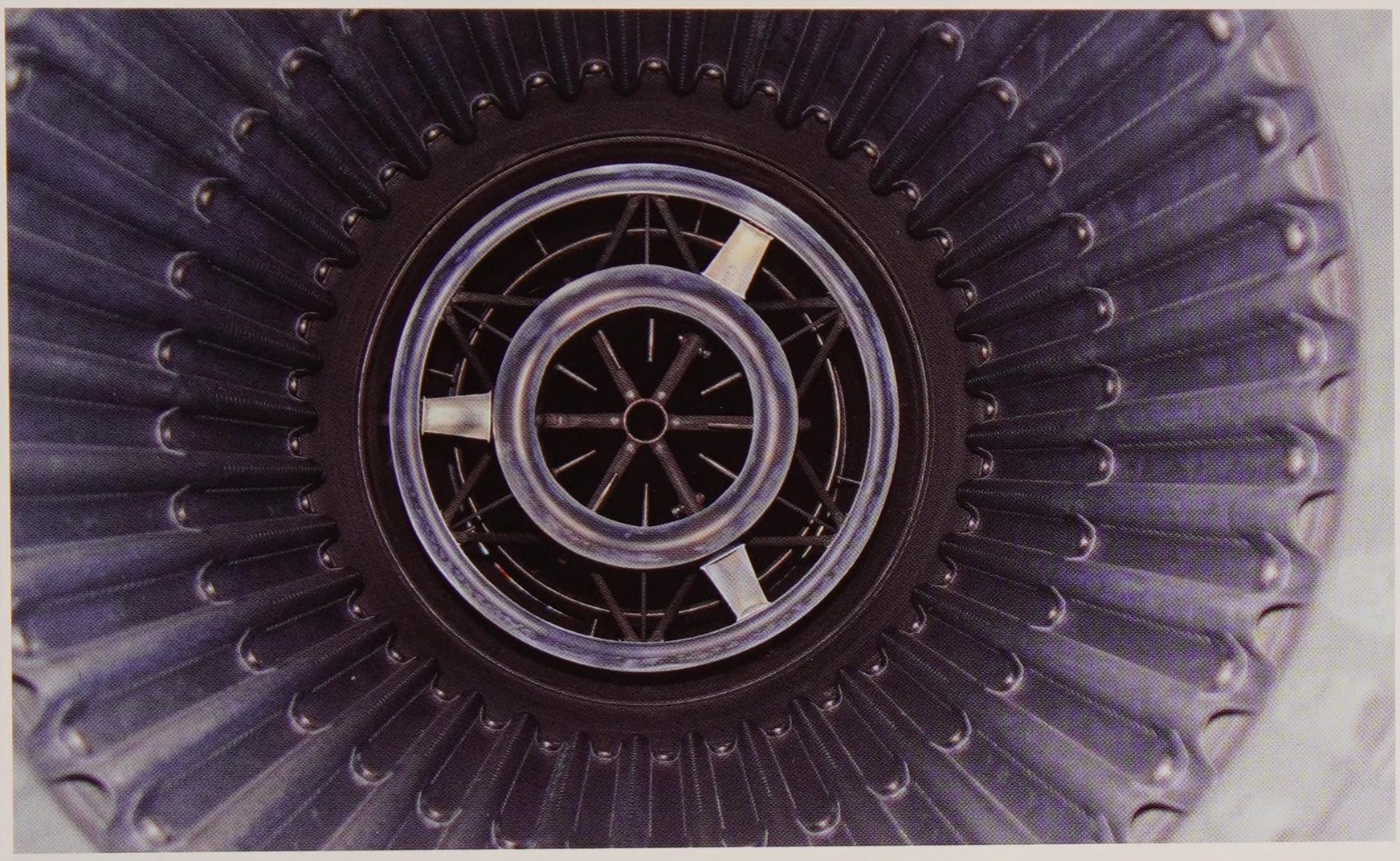


Port tail plane. The small 'jet pipe' above the tail plane is the turbine exhaust for the main accessory drive unit.

Port airbrake extended.



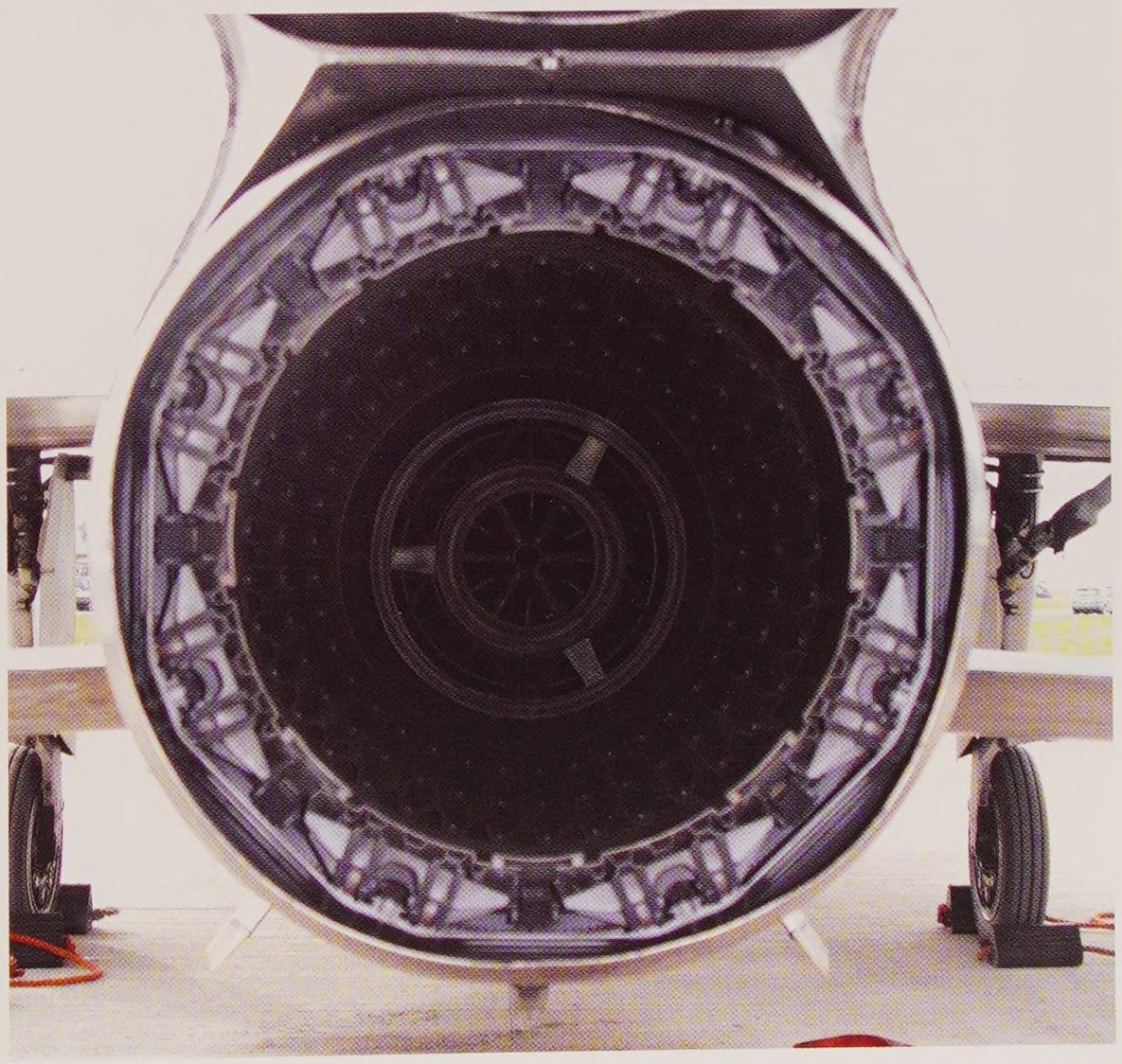
Port airbrake closed.

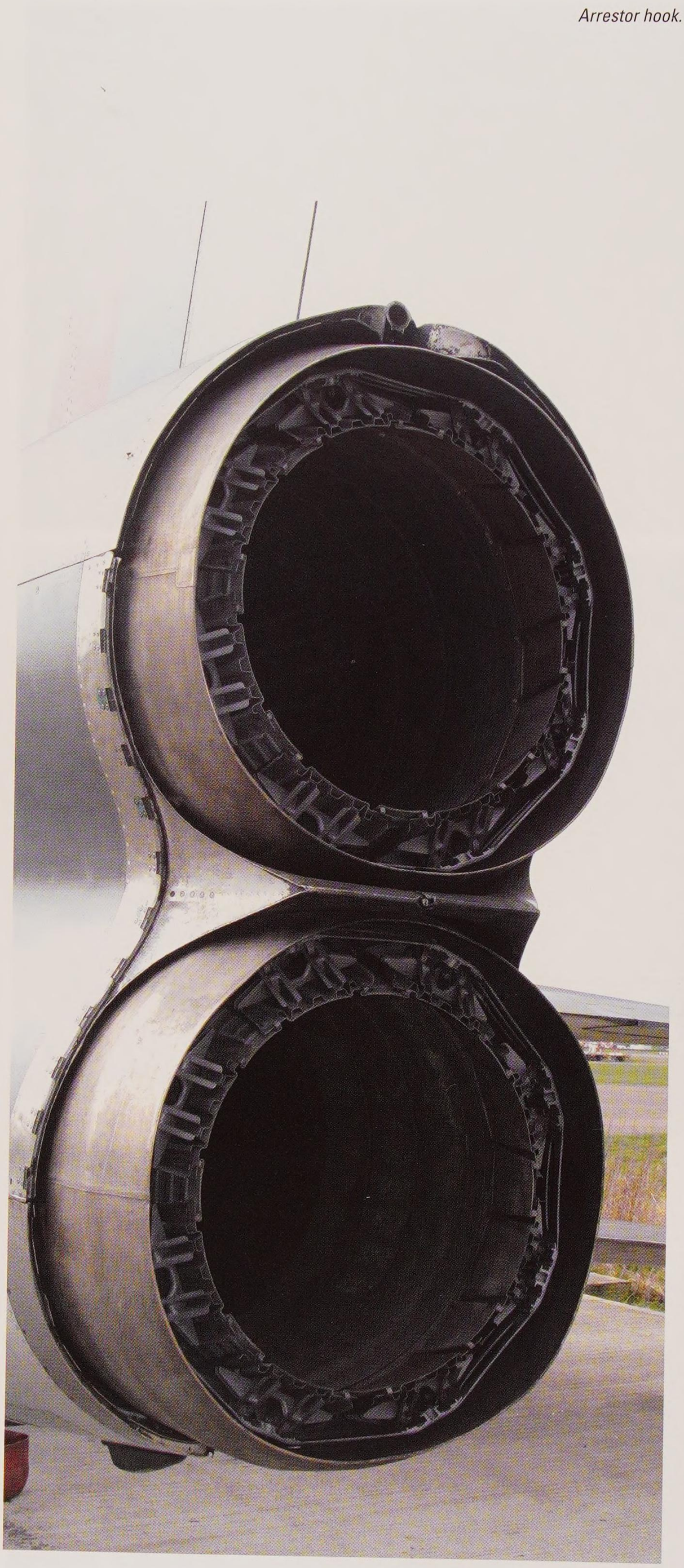


Jet pipe interior.

Lower jet pipe.

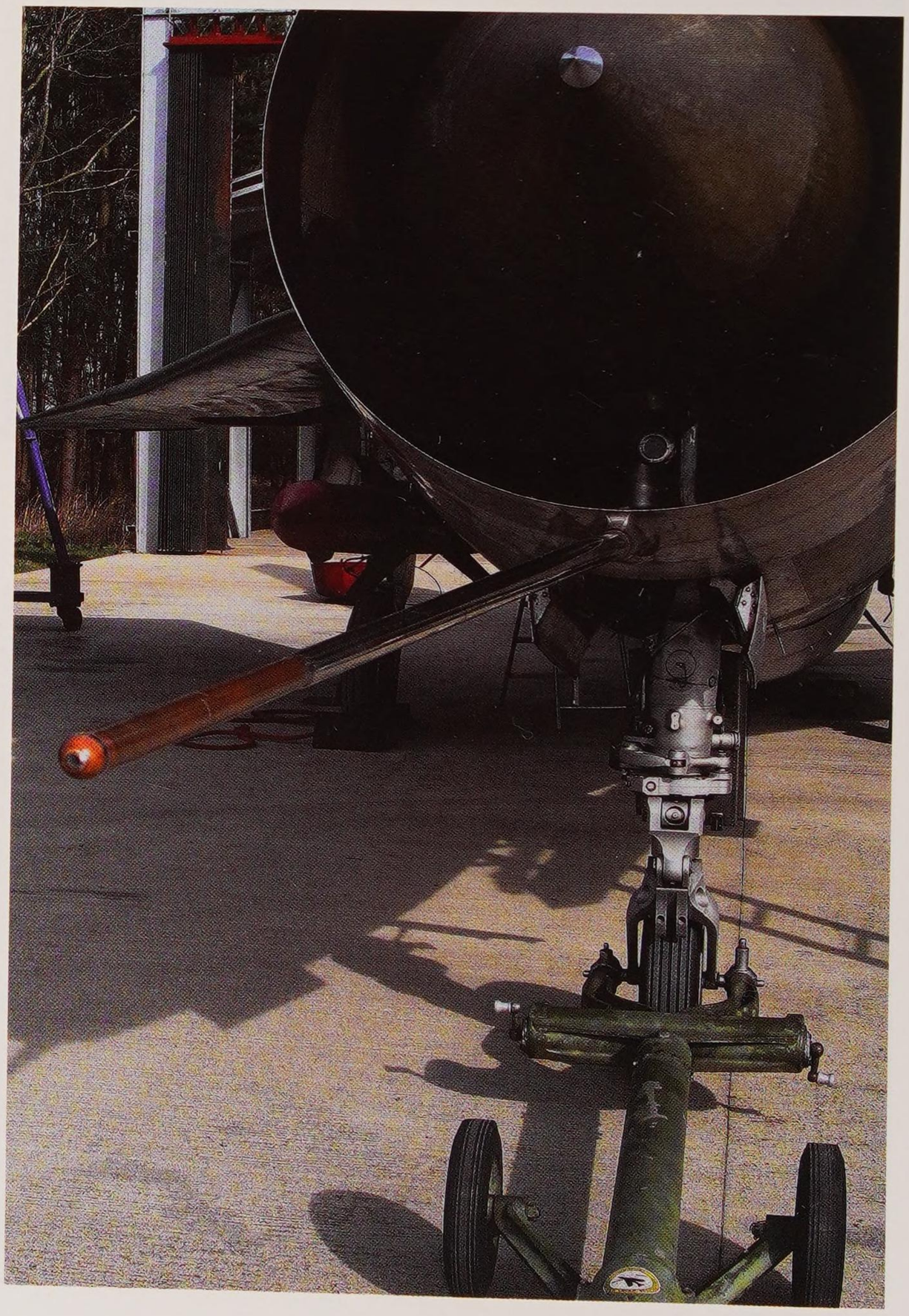
Rear fuselage and jet pipes.



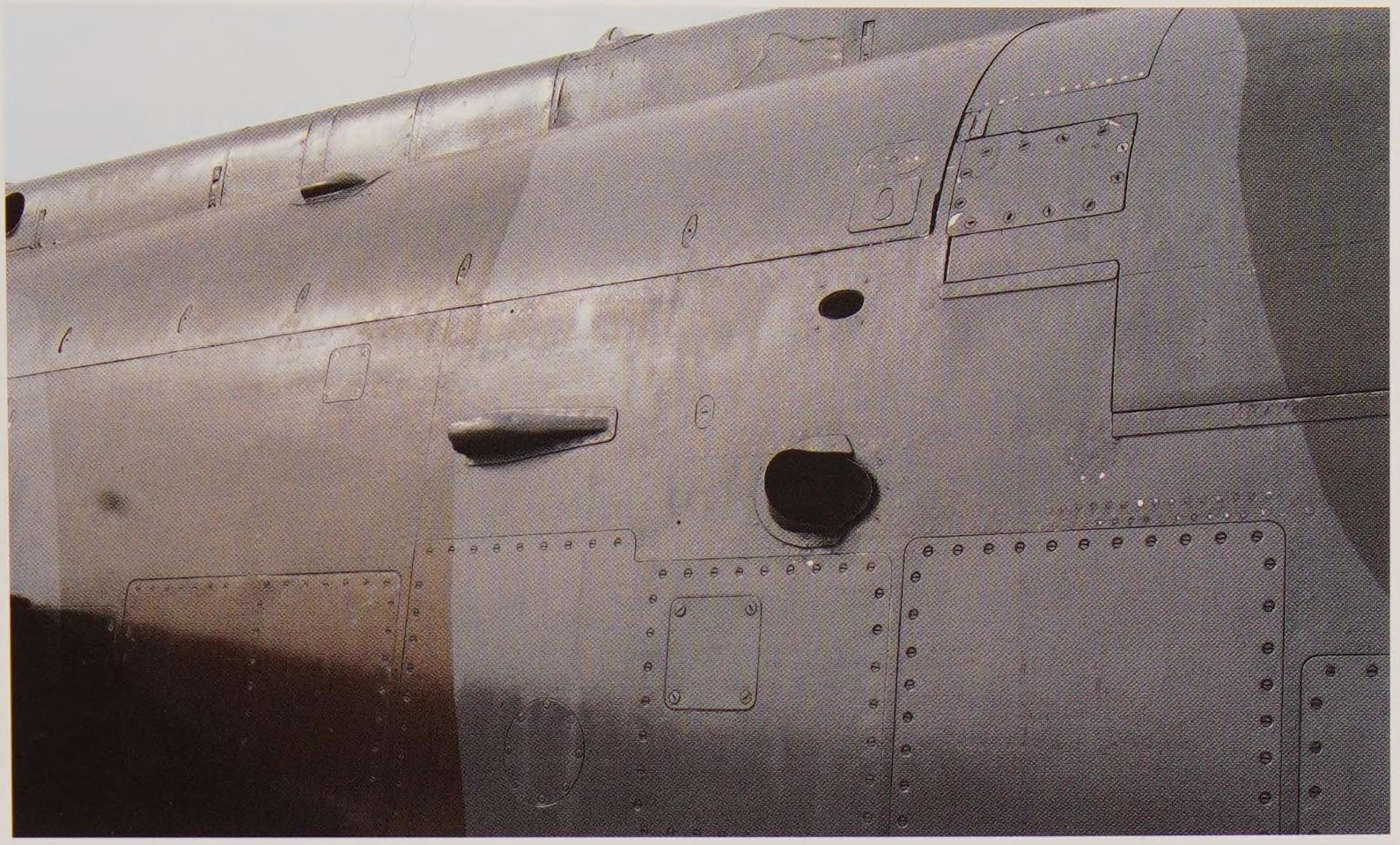


Detail of exterior of jet pipes.

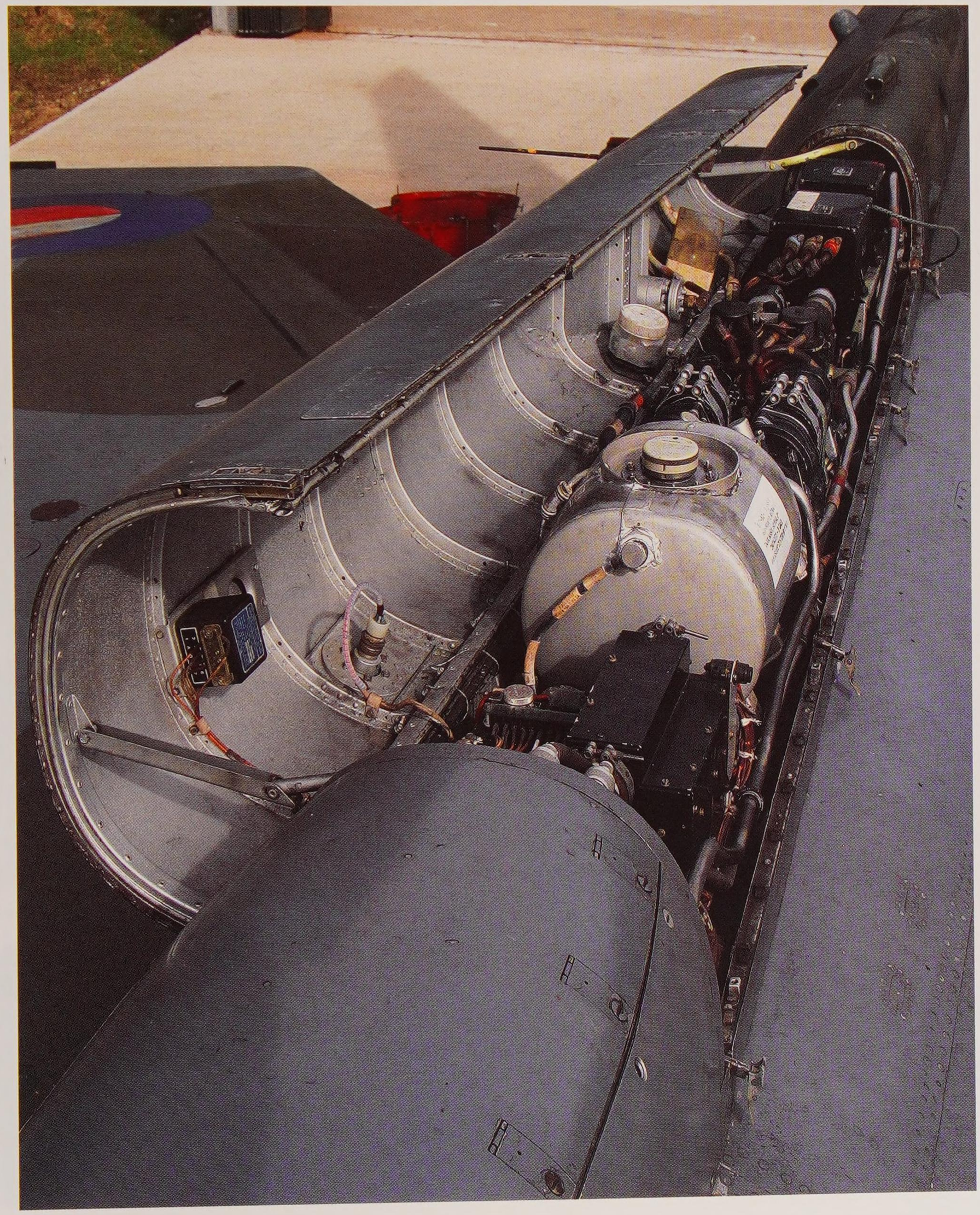
Arrestor hook.



Pitot tube.

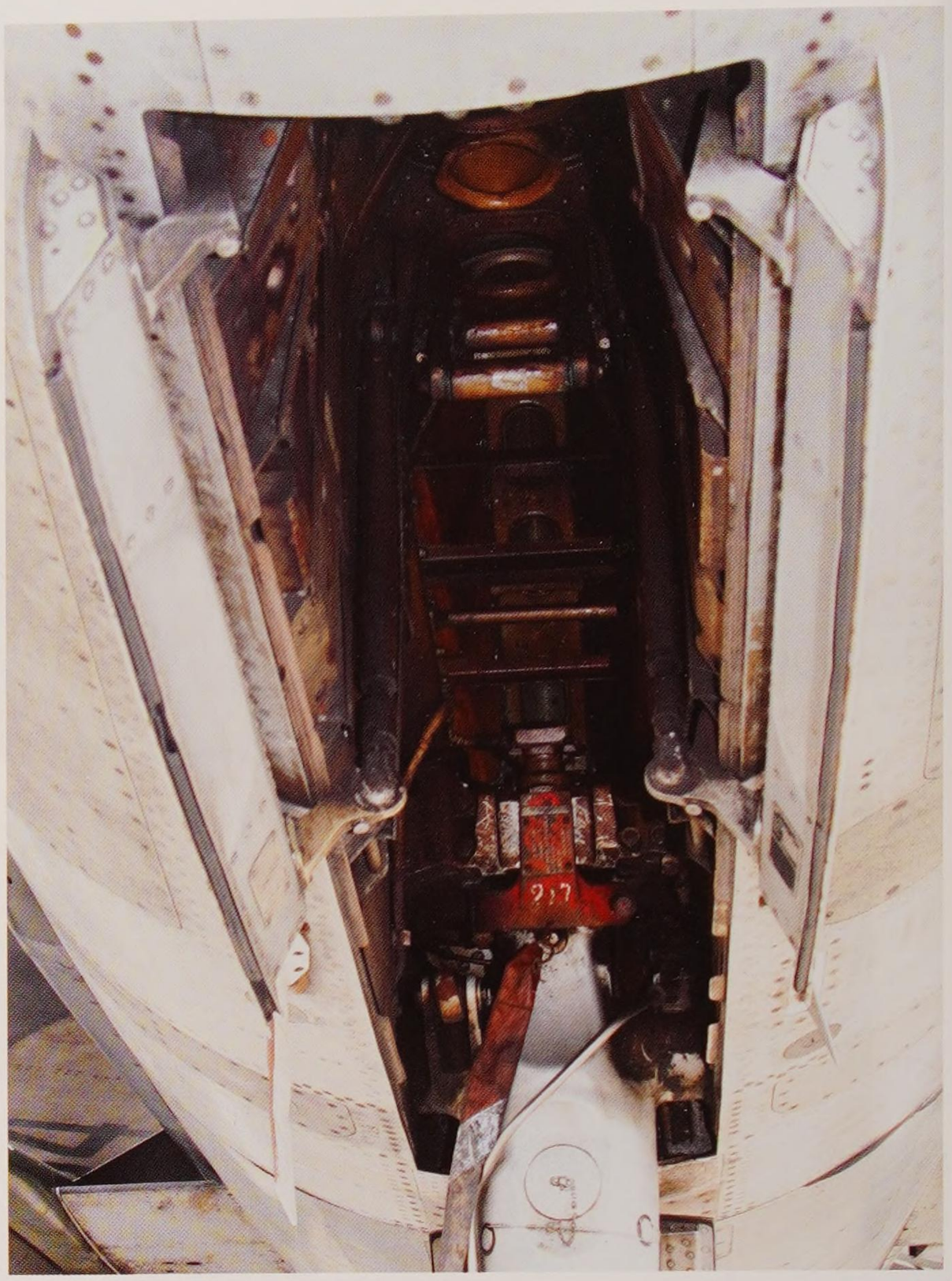


Port rear fuselage.

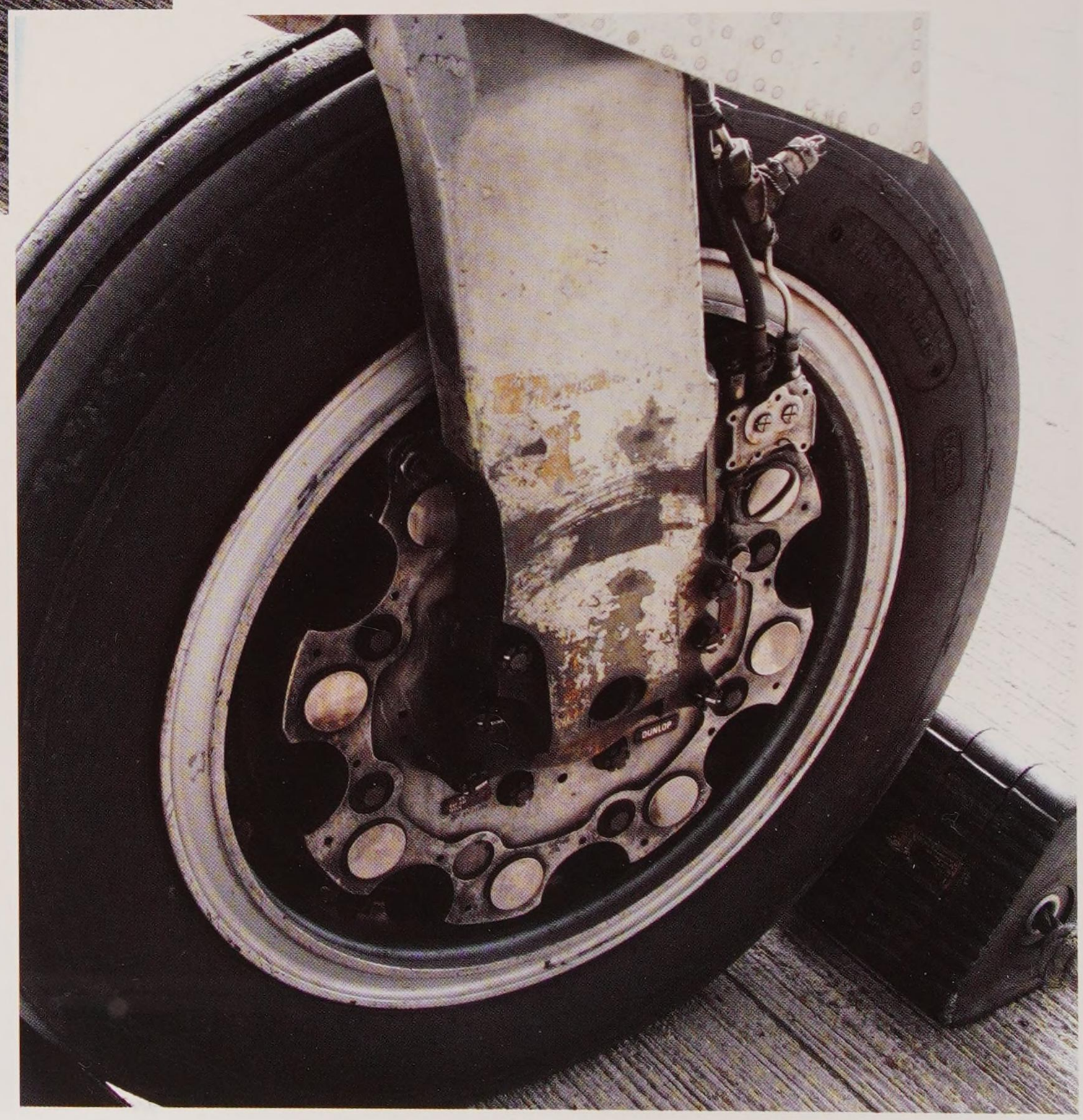


Fuselage spine and AVP fuel tank (in silver) with engine starting equipment directly behind.

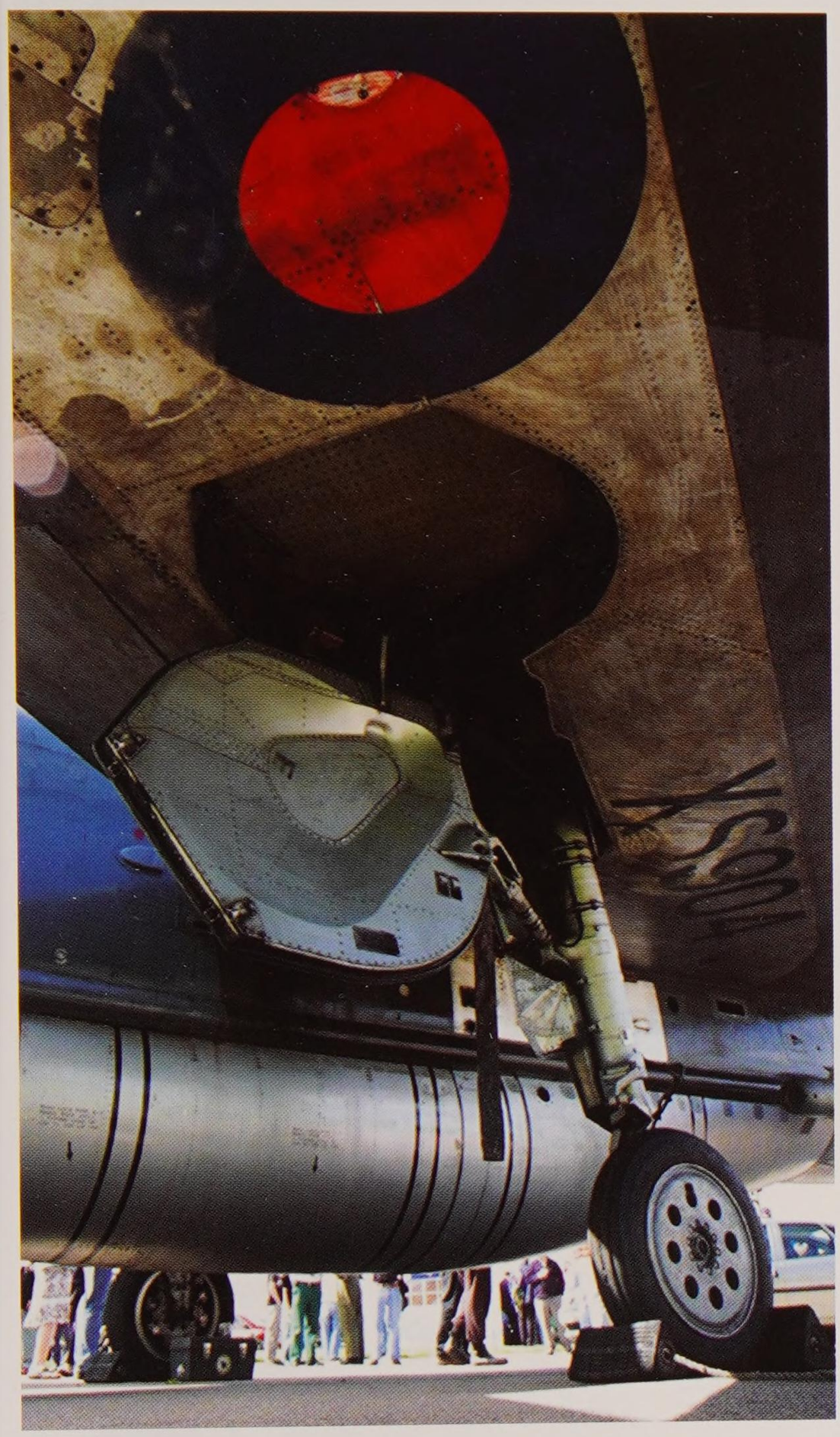
Nose wheel and leg.



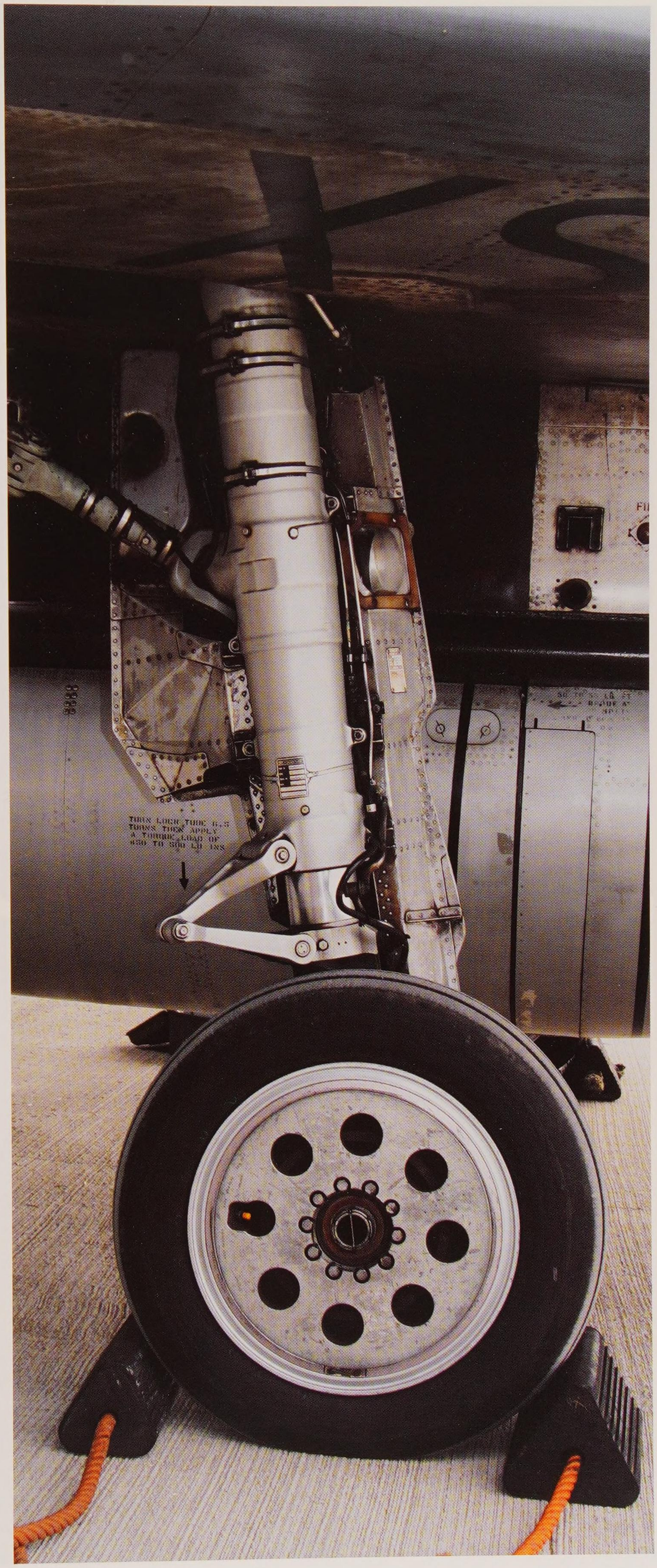
Above right: Nose wheel gear fuselage bay.



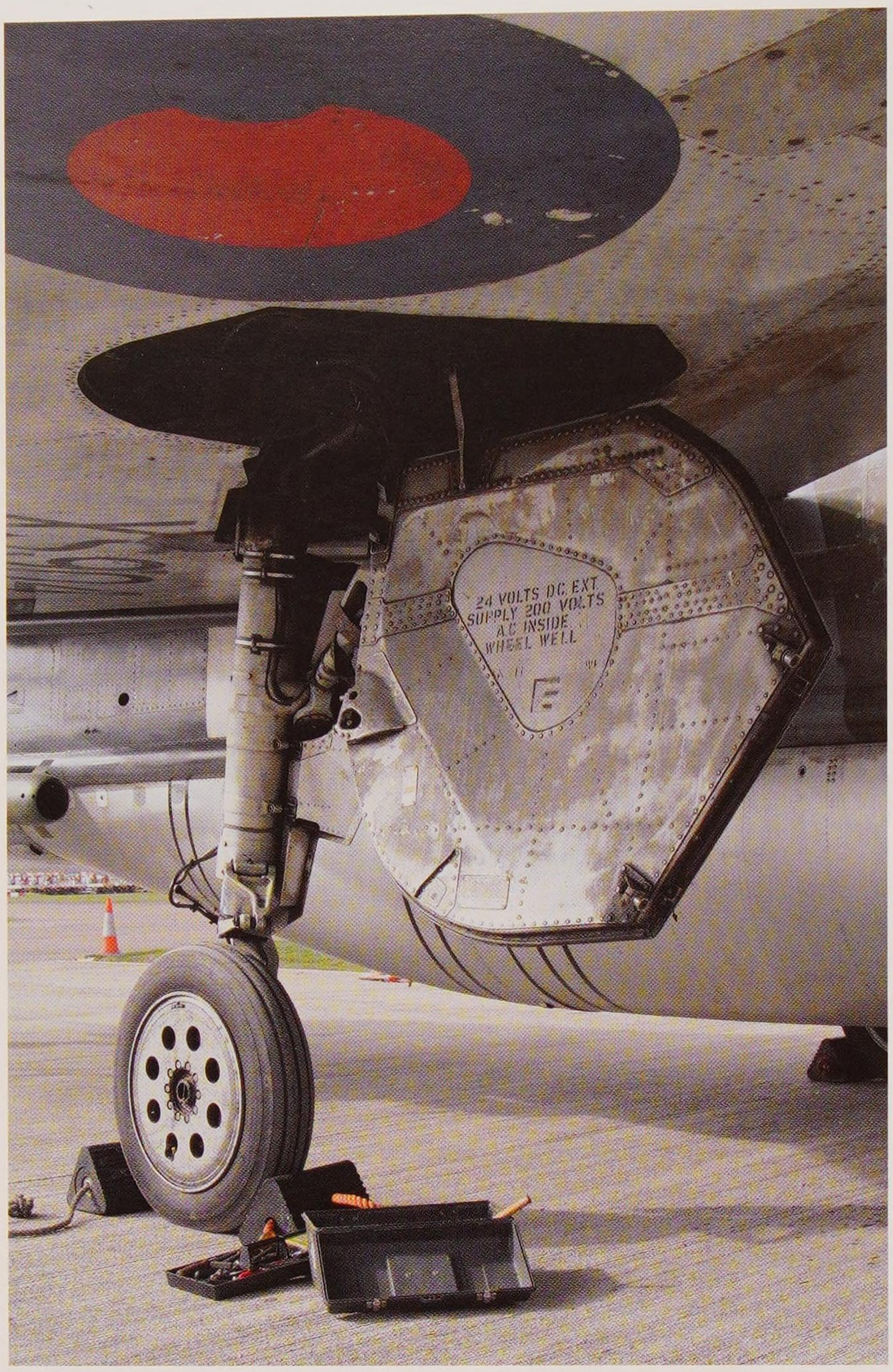
Port main wheel.



Starboard main undercarriage.

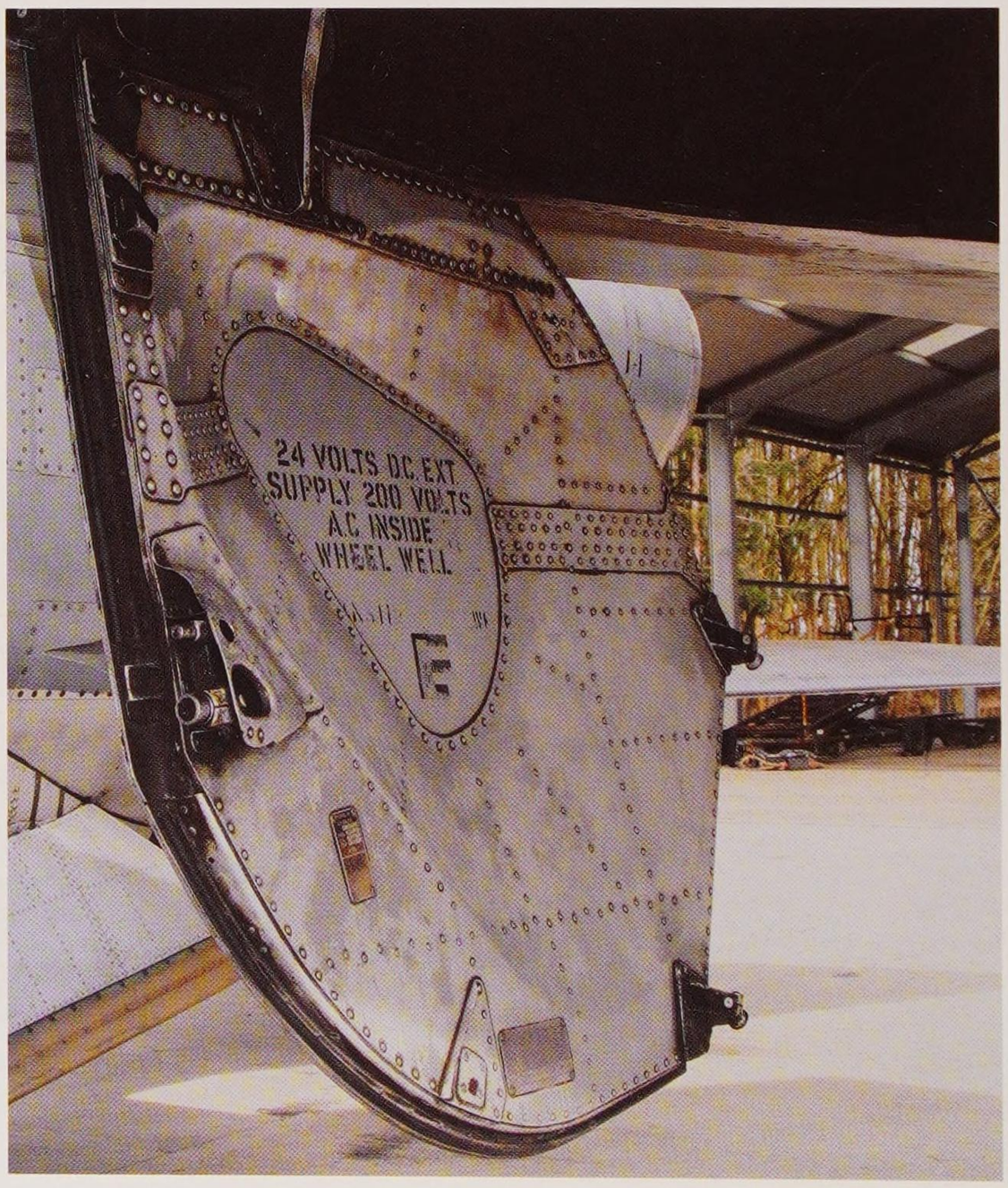


Starboard main undercarriage wheel and oleo leg.



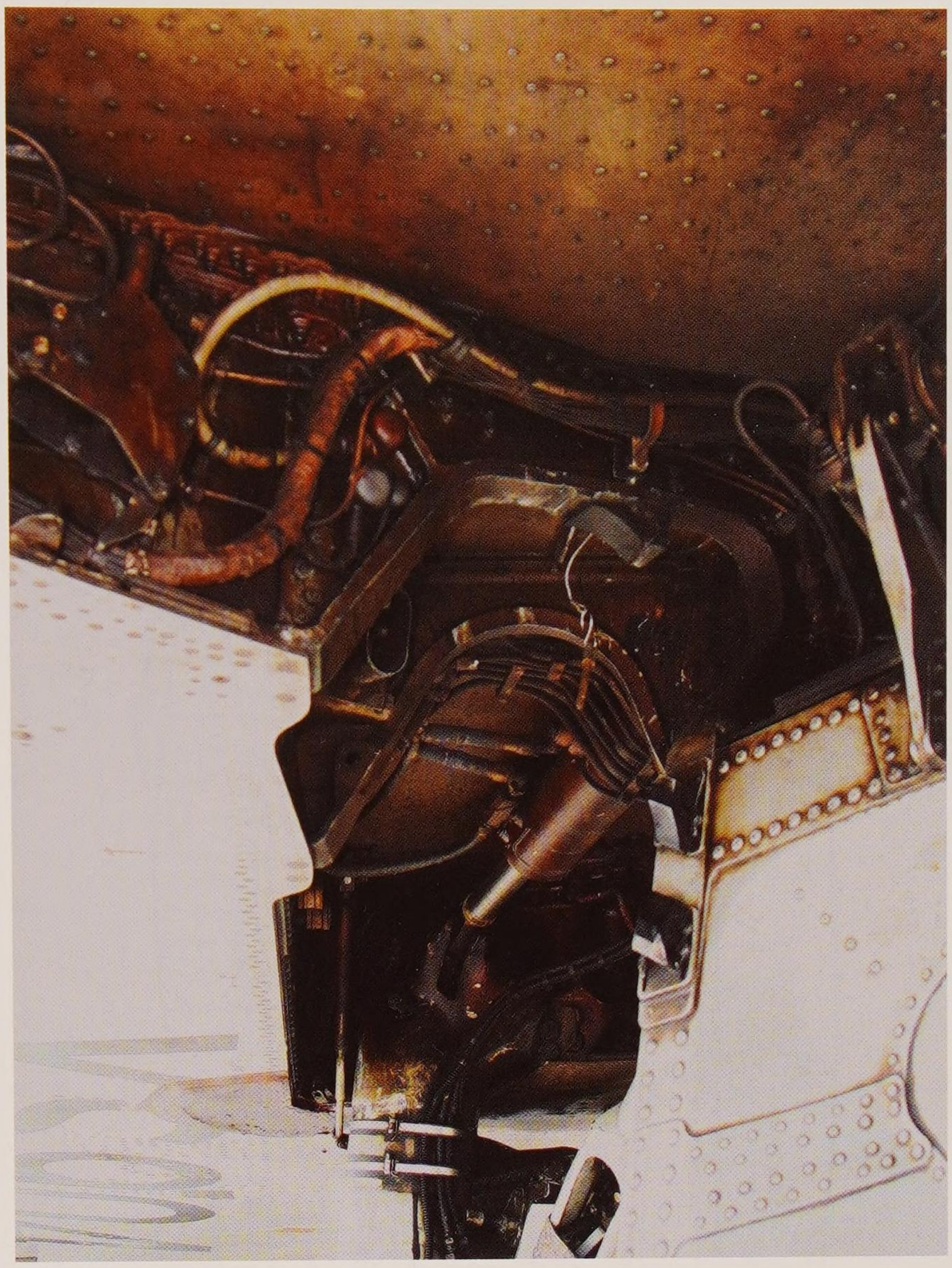
Port main undercarriage.

Starboard main gear and landing light.



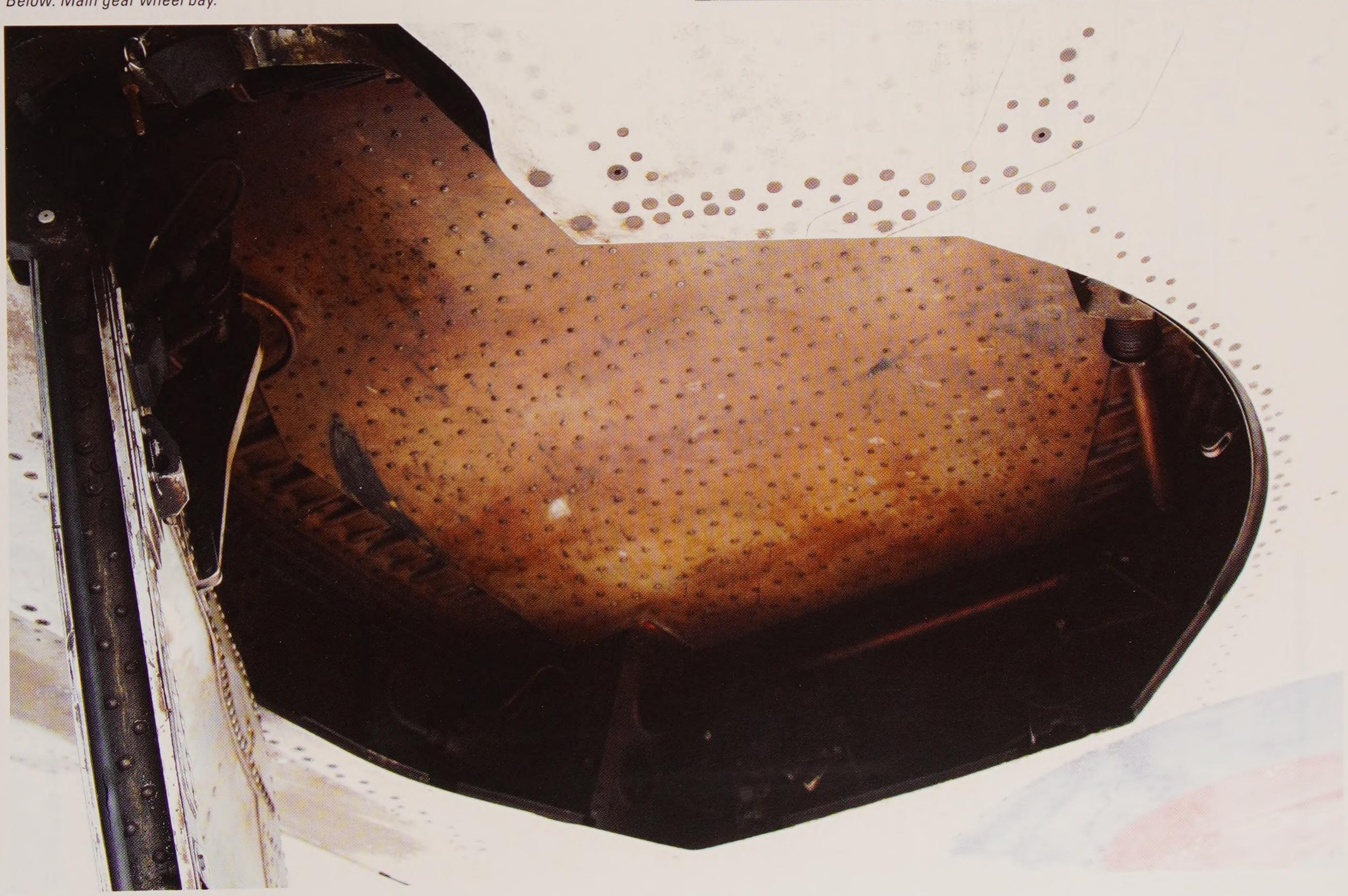
Port main gear door.

Main gear oleo attachment point.

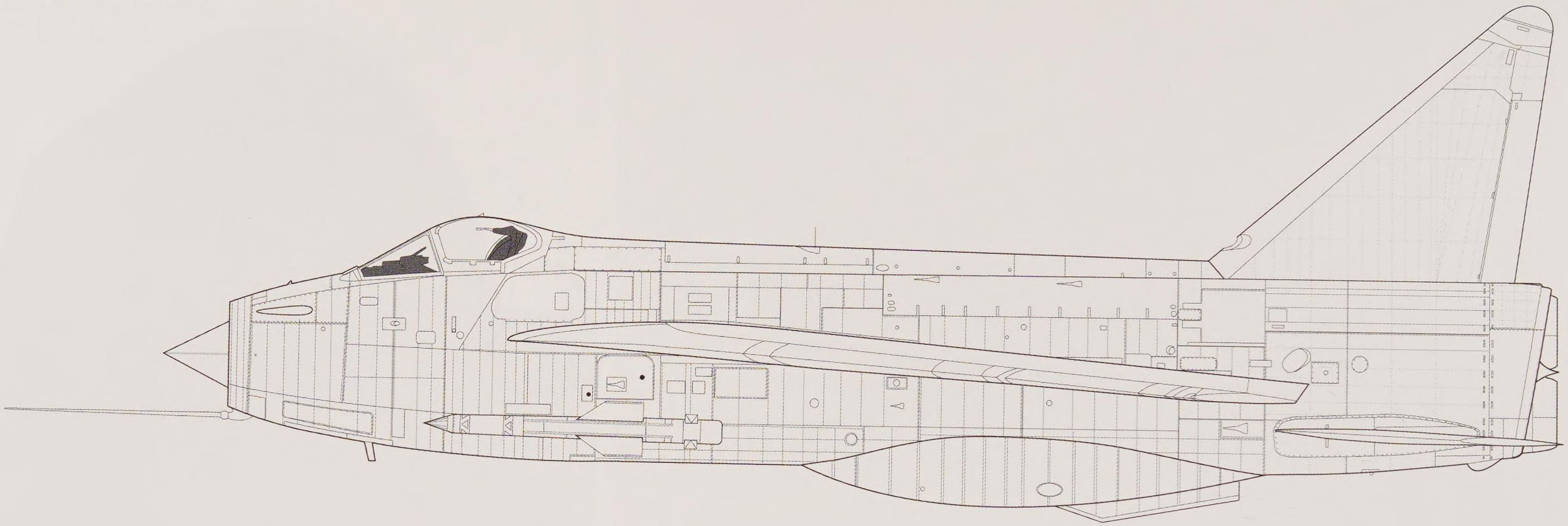


Right: Main gear bay detail.

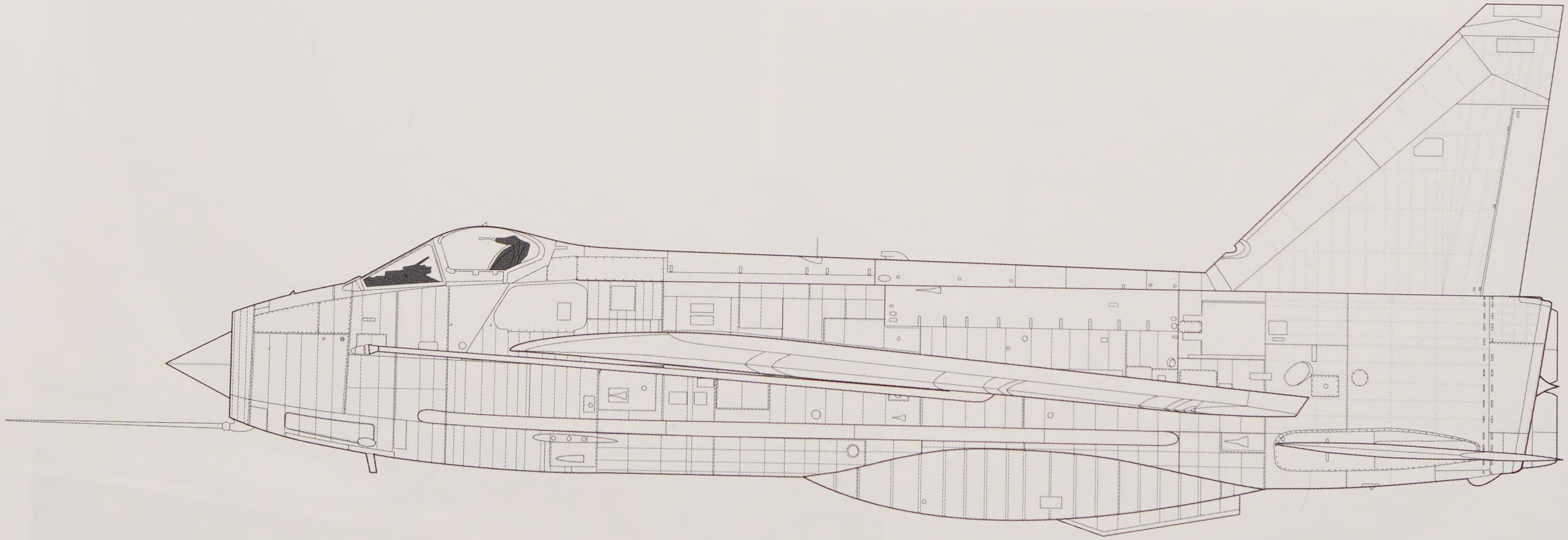
Below: Main gear wheel bay.



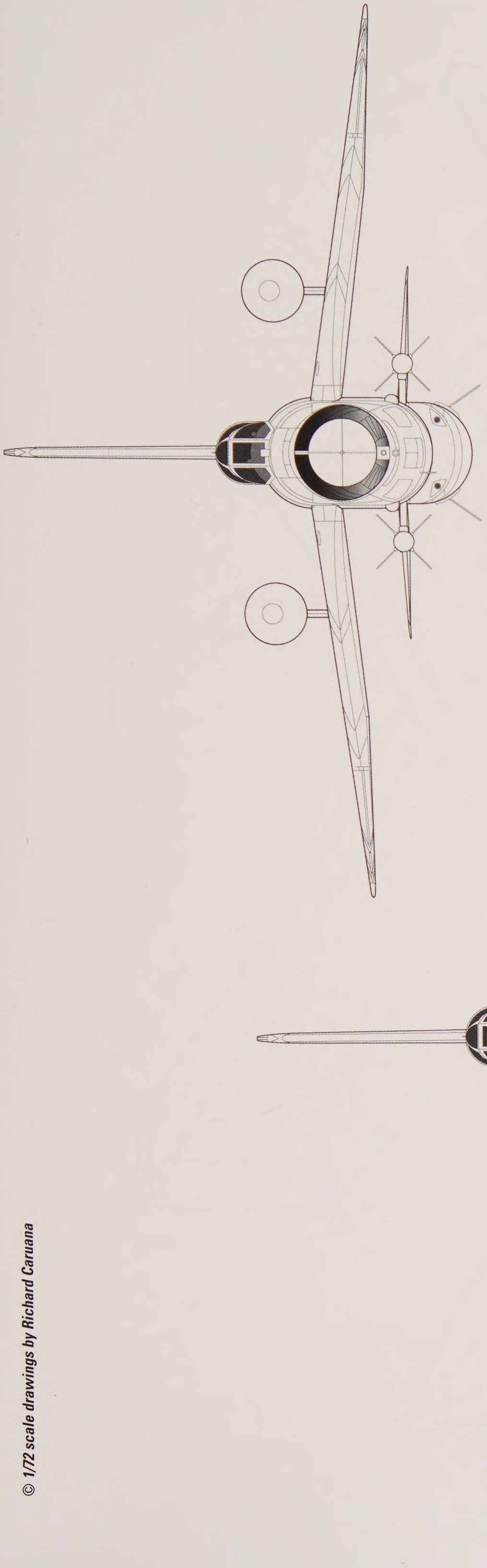
© 1/72 scale drawings by Richard Caruana

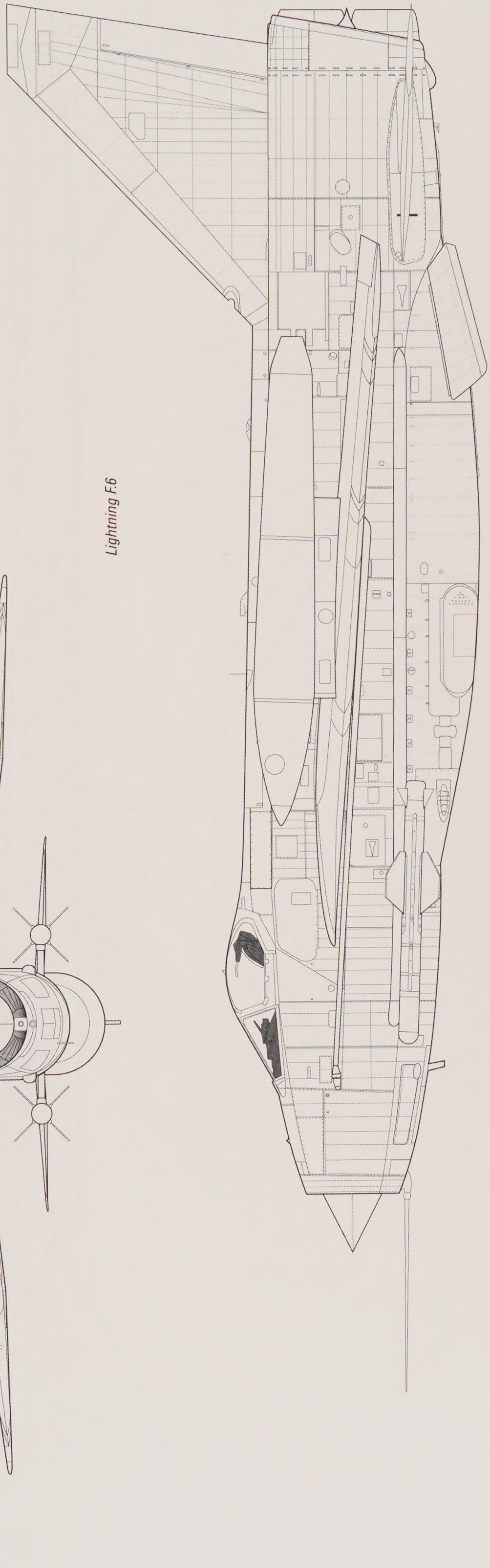


Lightning F.1



Lightning F.3





Lightning F.6

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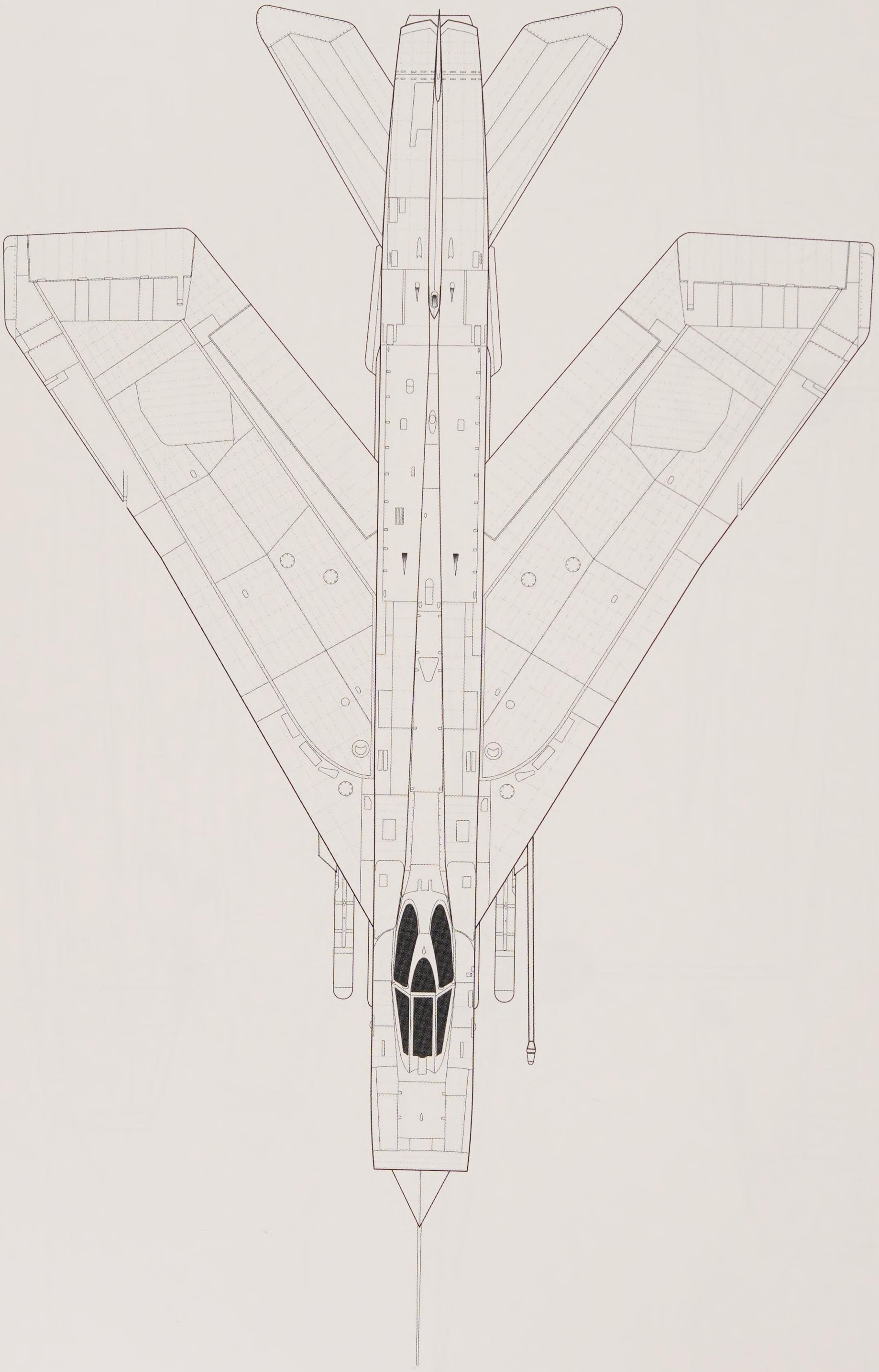
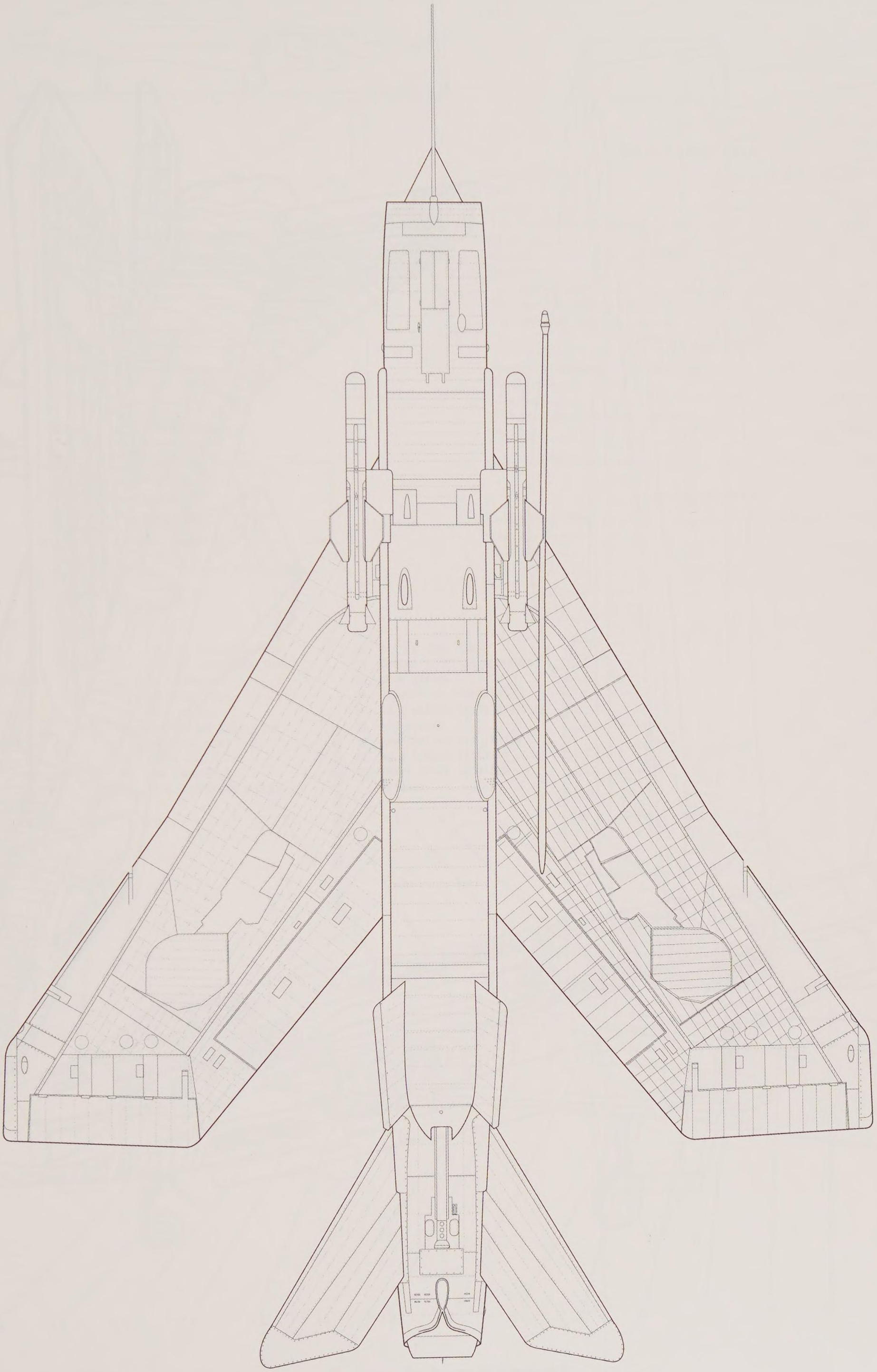


Lightning F.6

© 1/72 scale drawings by Richard Caruana



Lightning F.6

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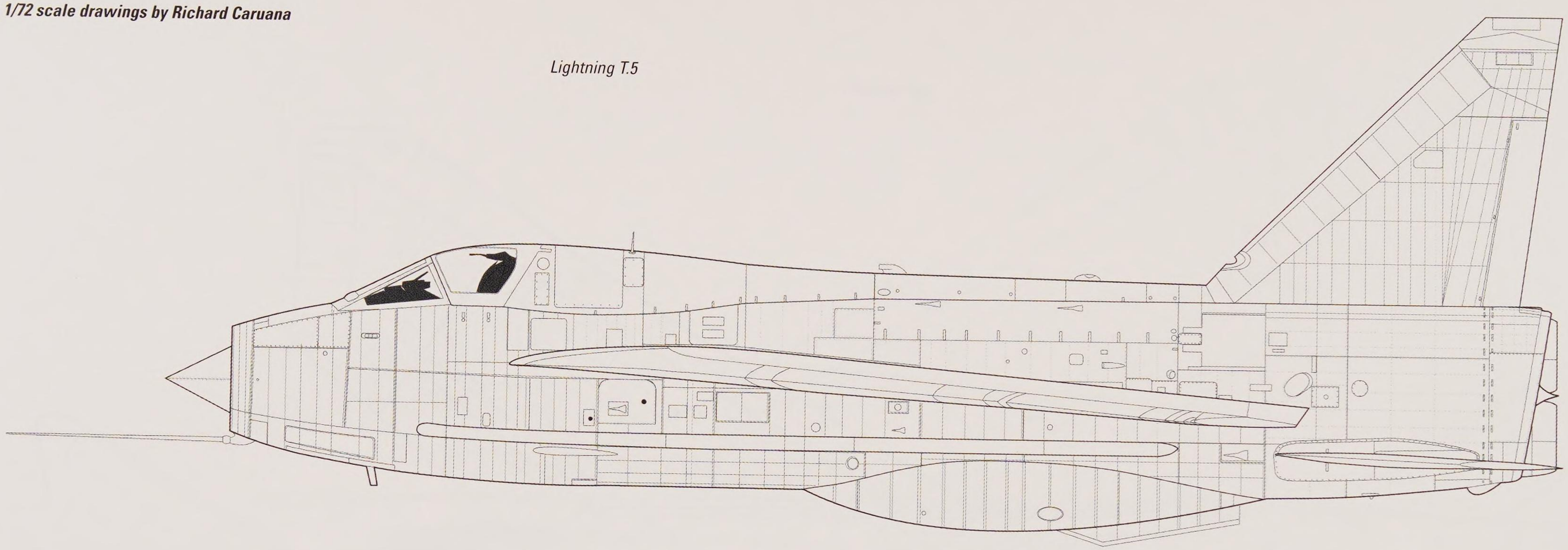
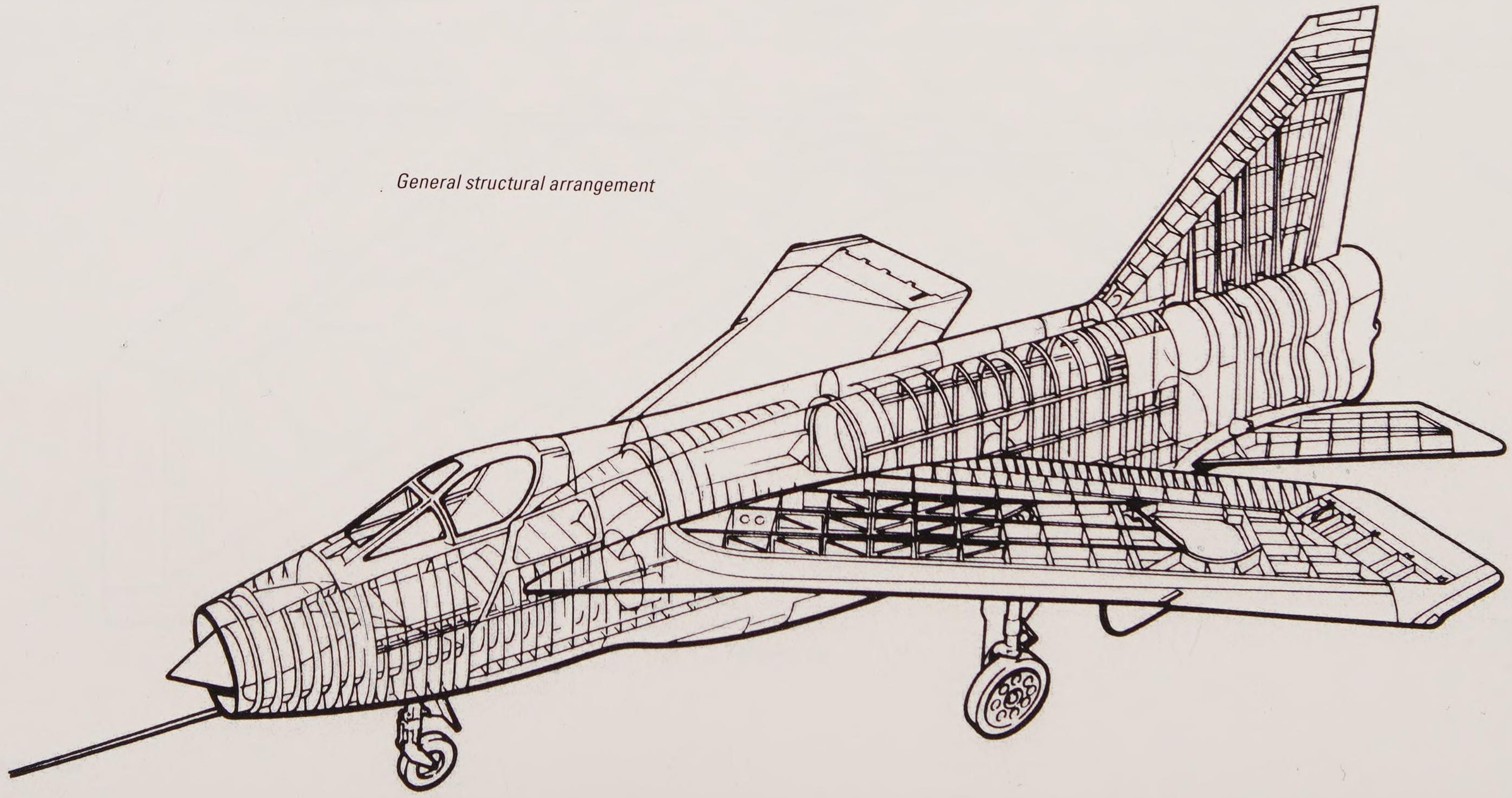
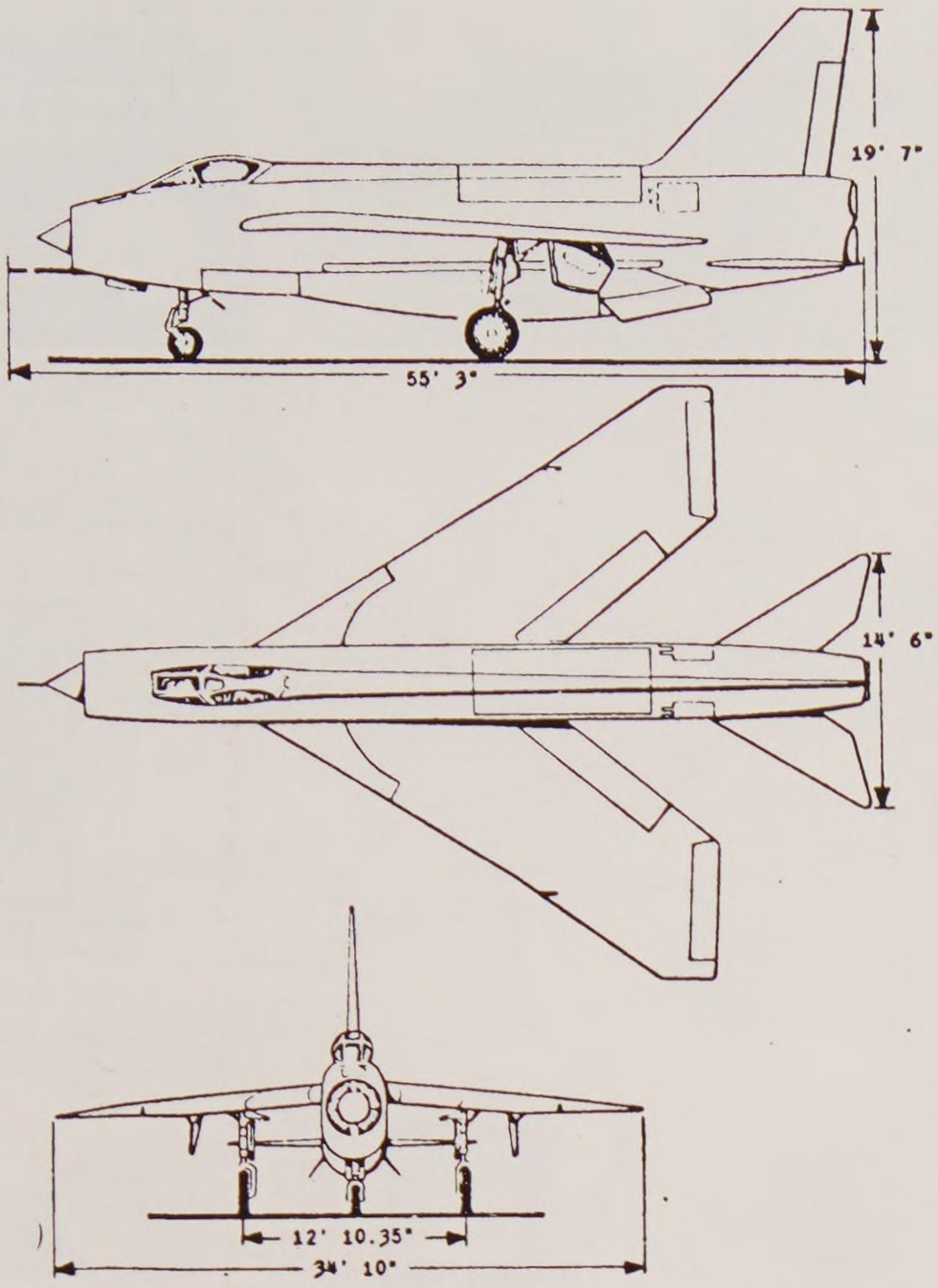
Lightning T.5



General structural arrangement





General arrangement

LEADING PARTICULARS

NAME.....LIGHTNING
TYPE.....TWIN-ENGINED, MID-WING MONOPLANE
DUTY.....INTERCEPTOR FIGHTER
CREW.....ONE

MAIN-PLANE DATA

Aerofoil section.....*E.E.A. Ltd. ASW/P1/3*
Chord
at root.....*222 in.*
at tip (theoretical).....*40.00 in.*
Incidence.....*2 deg*
Anhedral.....*3 deg*
Sweepback
at leading edge.....*60 deg*
at cambered leading edge.....*55½ deg*
at trailing edge.....*51 deg 56 min*

TAIL-PLANE DATA

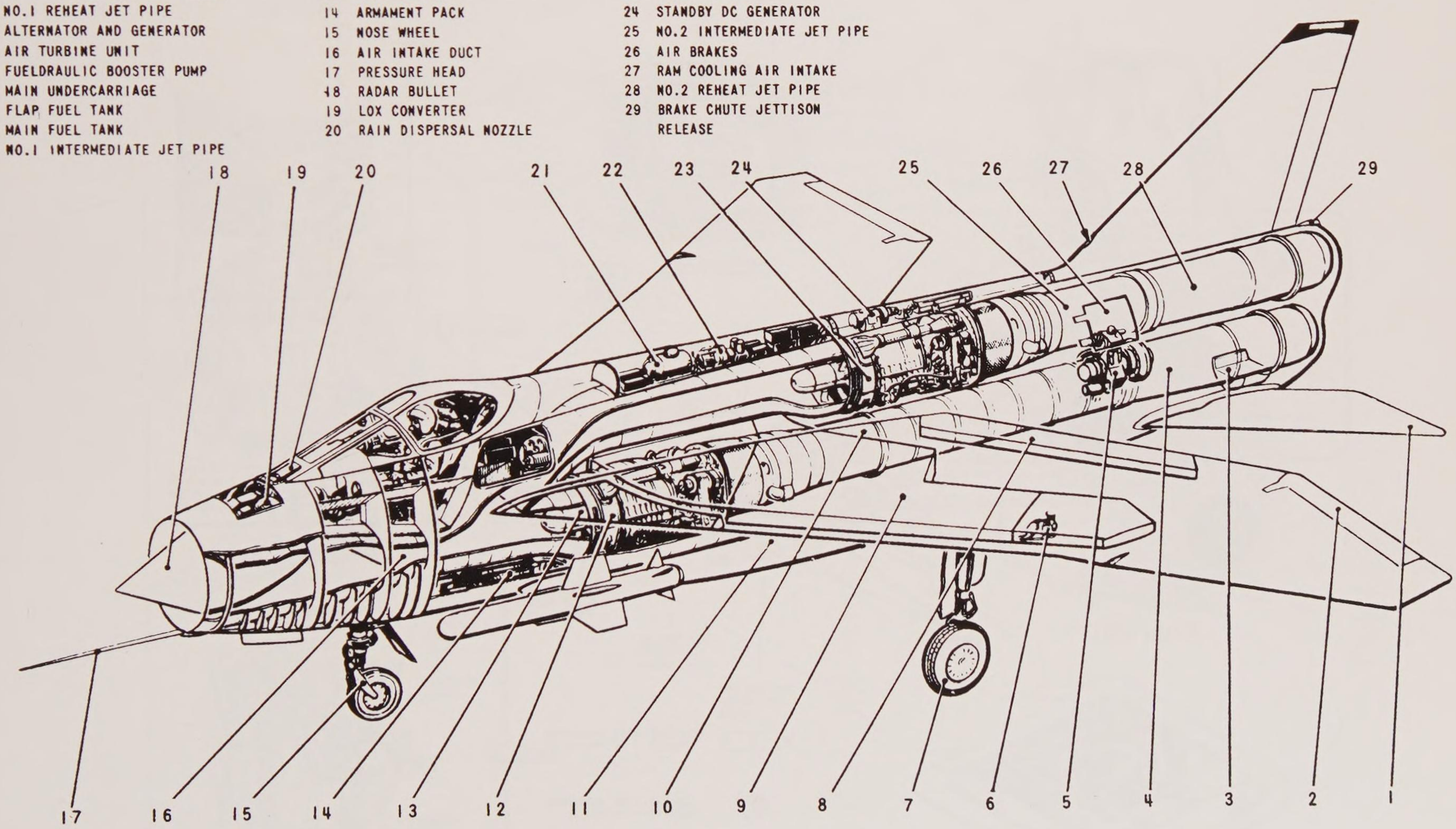
Aerofoil section.....*E.E.A. Ltd. ASW/P1/3*
Chord
at root.....*84.96 in.*
at tip (theoretical).....*12 in.*
Incidence.....*Variable*

Sweepback at leading edge.....*60 deg*

FIN AND RUDDER

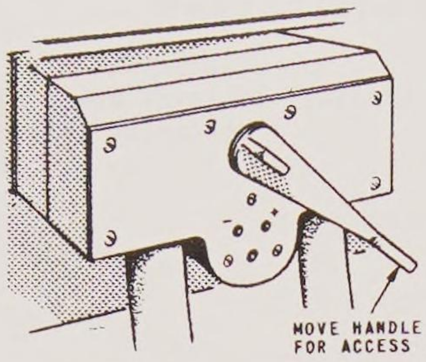
Aerofoil section.....*E.E.A. Ltd. ASW/P1/3*
Chord
at root.....*137.2 in.*
at tip.....*38 in.*

1 ALL-MOVING TAILPLANE
2 AILERON
3 BRAKE PARACHUTE COMPARTMENT
4 NO.1 REHEAT JET PIPE
5 ALTERNATOR AND GENERATOR AIR TURBINE UNIT
6 FUELDRAULIC BOOSTER PUMP
7 MAIN UNDERCARRIAGE
8 FLAP FUEL TANK
9 MAIN FUEL TANK
10 NO.1 INTERMEDIATE JET PIPE
11 VENTRAL FUEL/GUN PACK
12 LEADING EDGE FUEL TANK
13 NO.1 ENGINE
14 ARMAMENT PACK
15 NOSE WHEEL
16 AIR INTAKE DUCT
17 PRESSURE HEAD
18 RADAR BULLET
19 LOX CONVERTER
20 RAIN DISPERSAL NOZZLE
21 AVP IN FUEL TANK
22 ENGINE STARTING EQUIPMENT
23 NO.2 ENGINE
24 STANDBY DC GENERATOR
25 NO.2 INTERMEDIATE JET PIPE
26 AIR BRAKES
27 RAM COOLING AIR INTAKE
28 NO.2 REHEAT JET PIPE
29 BRAKE CHUTE JETTISON RELEASE

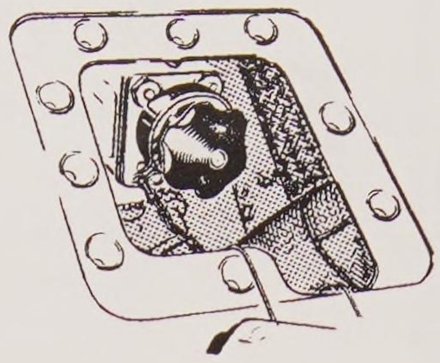


General Arrangement

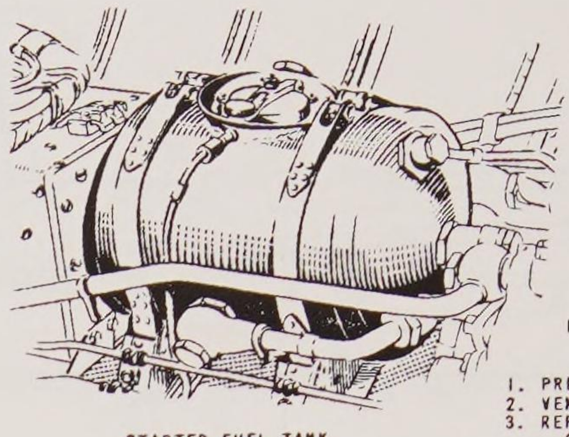
53-#001-1



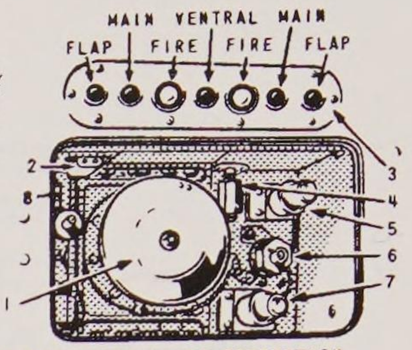
BATTERY TEST SOCKET



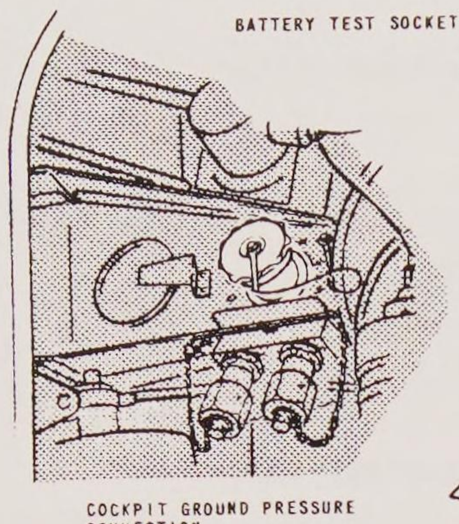
REHEAT FUEL PUMP OIL FILLER



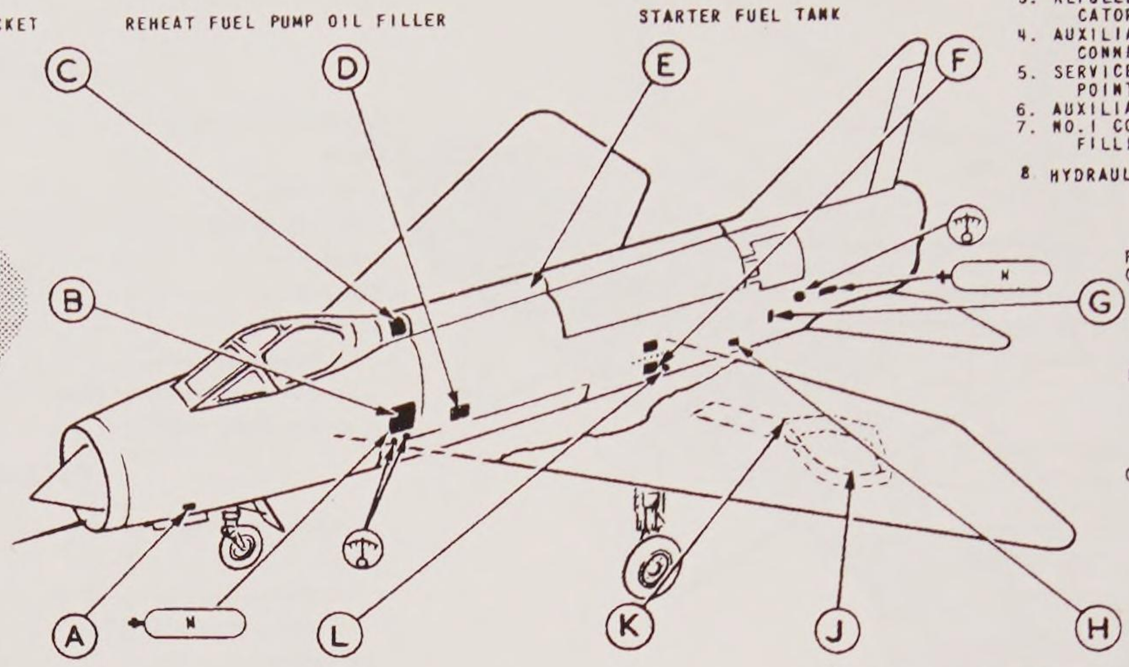
STARTER FUEL TANK

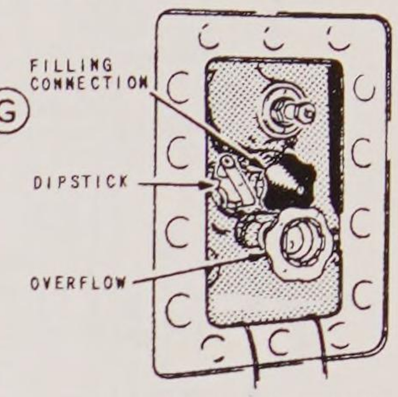


1. PRESSURE REFUELLING CONNECTION
2. VENTRAL TANK ATTACHMENT TEST POINT
3. REFUELLING AND FIRE EXTINGUISHER INDICATORS
4. AUXILIARY AIR SYSTEM TEST GAUGE CONNECTION
5. SERVICES HYDRAULIC RESERVOIR FILLING POINT
6. AUXILIARY AIR SYSTEM GROUND TEST POINT
7. NO.1 CONTROLS HYDRAULIC RESERVOIR FILLING POINT
8. HYDRAULIC RESERVOIRS AIR RELEASE

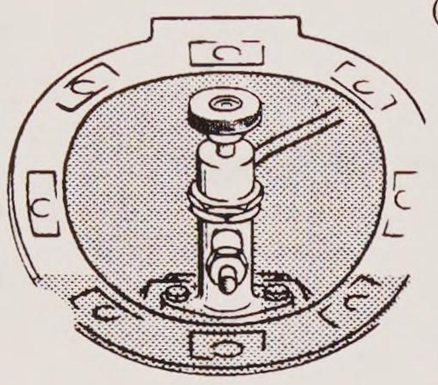


COCKPIT GROUND PRESSURE CONNECTION

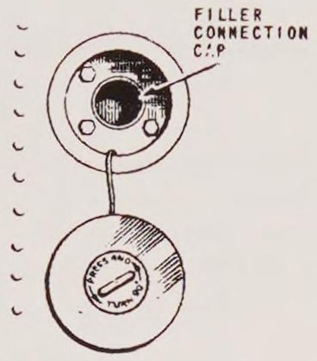




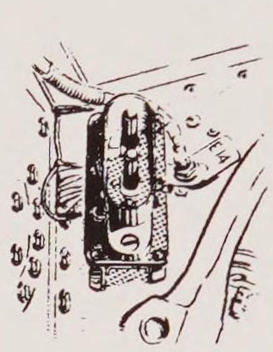
ACCESSORY DRIVE GEARBOX FILLING



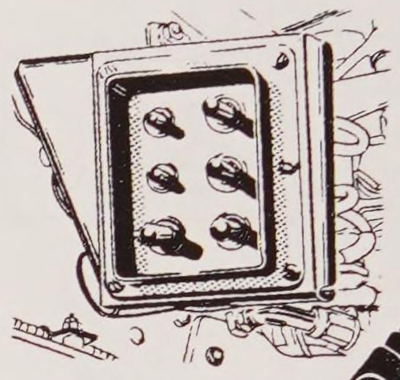
OXYGEN CHARGING VALVE



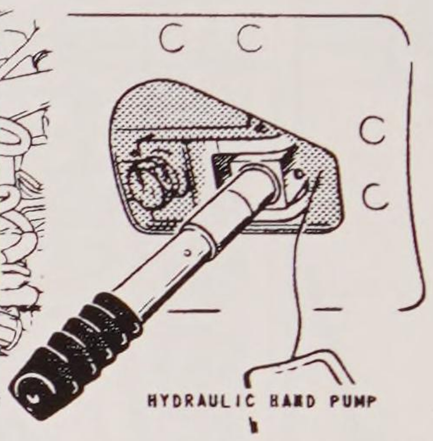
NO.2 ENGINE REHEAT FUEL PUMP OIL FILLER



D.C. GROUND SUPPLY SOCKET

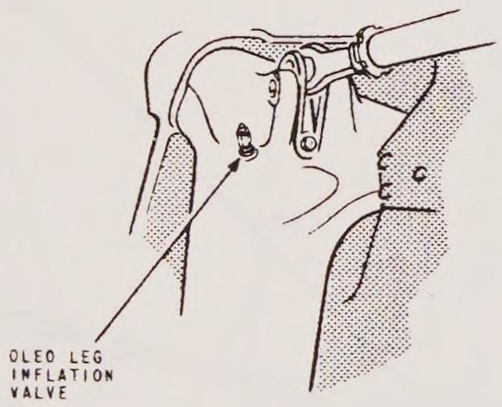


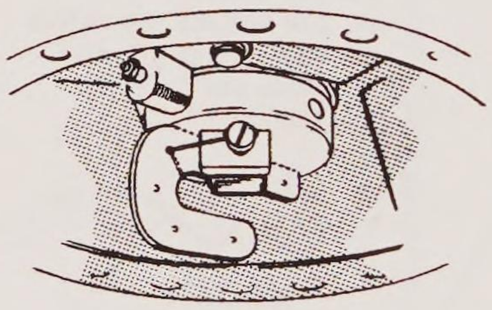
A.C. GROUND SUPPLY SOCKET



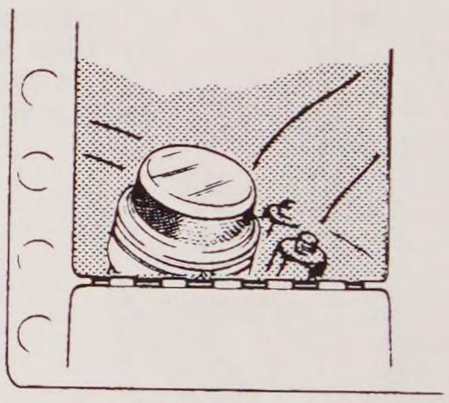
HYDRAULIC HAND PUMP

SERVICING POINTS

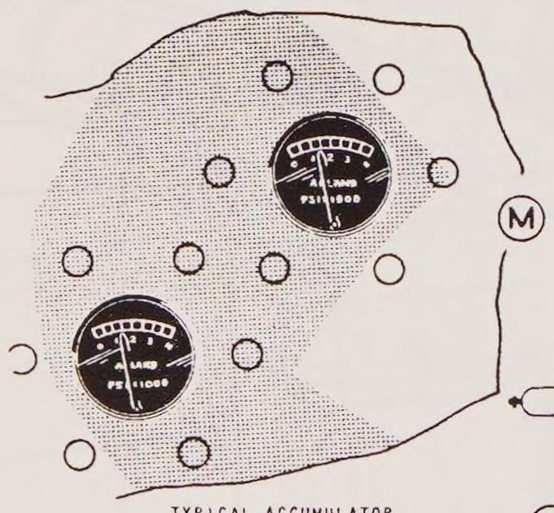




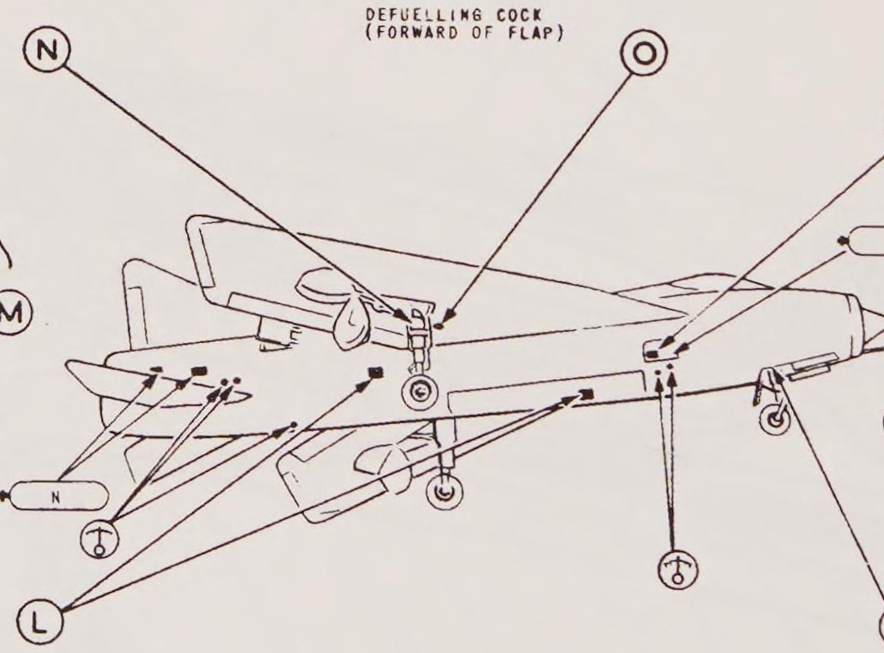
DEFUELLING COCK (FORWARD OF FLAP)

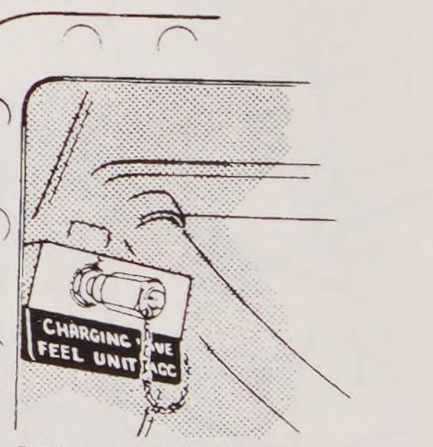


WATER SYSTEM REPLENISHING POINT

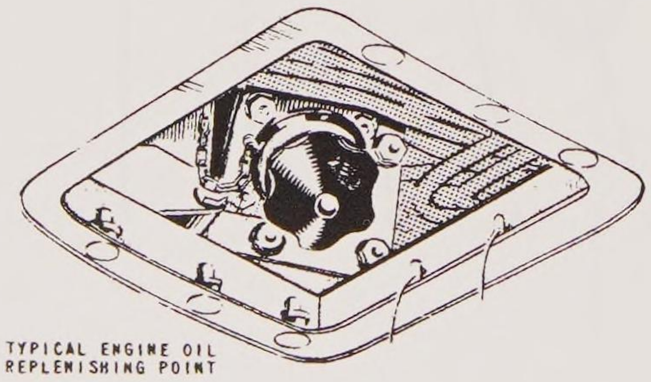


TYPICAL ACCUMULATOR PRESSURE GAUGES





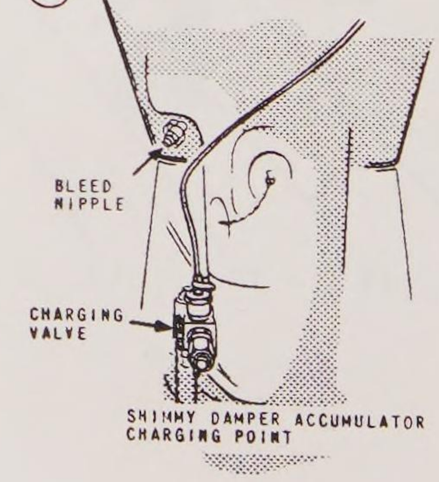
TYPICAL ACCUMULATOR CHARGING VALVE



TYPICAL ENGINE OIL REPLENISHING POINT

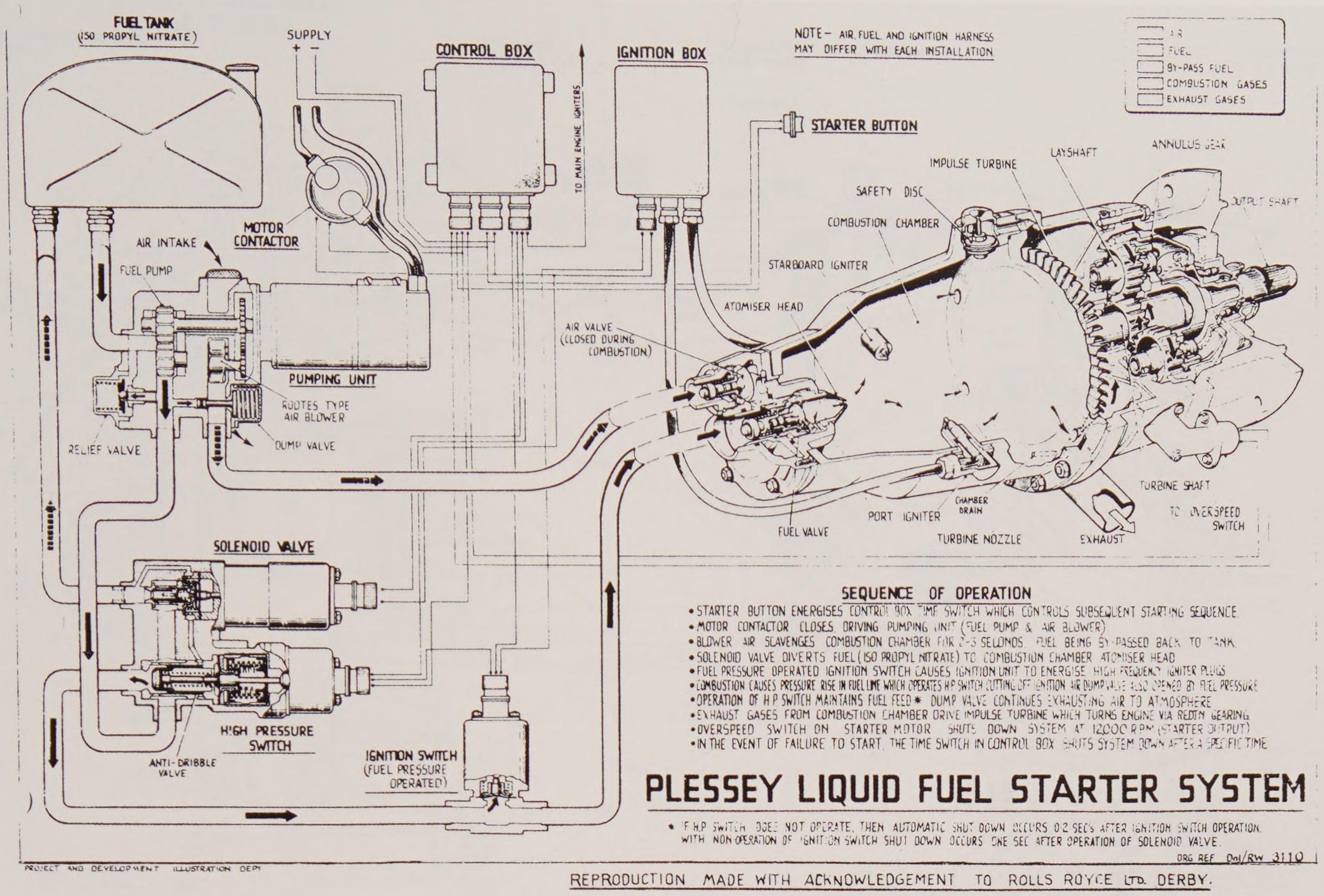
N — ACCUMULATOR CHARGING POINTS - DETAIL Q

ACCUMULATOR PRESSURE GAUGES - DETAIL M

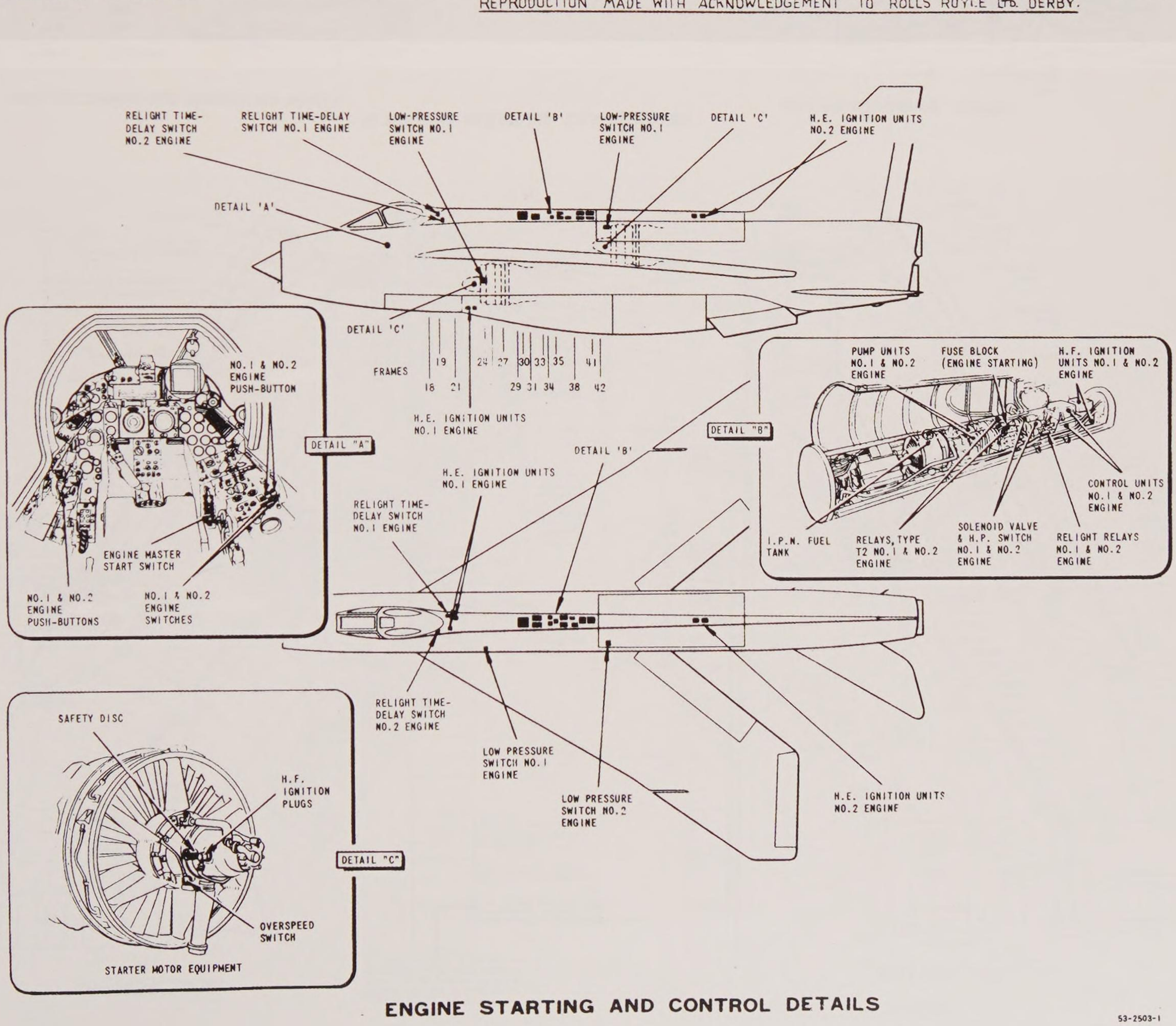


SHIMMY DAMPER ACCUMULATOR CHARGING POINT

SERVICING POINTS


FUEL TANK
(ISO PROPYL NITRATE)
SUPPLY
+ −
CONTROL BOX
IGNITION BOX
TO MAIN ENGINE IGNITERS
NOTE – AIR, FUEL AND IGNITION HARNESS MAY DIFFER WITH EACH INSTALLATION
AIR
FUEL
BY-PASS FUEL
COMBUSTION GASES
EXHAUST GASES
STARTER BUTTON
MOTOR CONTACTOR
AIR INTAKE
FUEL PUMP
PUMPING UNIT
ROOTES TYPE AIR BLOWER
DUMP VALVE
RELIEF VALVE
AIR VALVE (CLOSED DURING COMBUSTION)
ATOMISER HEAD
STARBOARD IGNITER
COMBUSTION CHAMBER
SAFETY DISC
IMPULSE TURBINE
LAYSHAFT
ANNULUS GEAR
OUTPUT SHAFT
TURBINE SHAFT
TO OVERSPEED SWITCH
CHAMBER DRAIN
PORT IGNITER
FUEL VALVE
TURBINE NOZZLE
EXHAUST
SOLENOID VALVE
HIGH PRESSURE SWITCH
ANTI-DRIBBLE VALVE
IGNITION SWITCH (FUEL PRESSURE OPERATED)
SEQUENCE OF OPERATION
• STARTER BUTTON ENERGISES CONTROL BOX TIME SWITCH WHICH CONTROLS SUBSEQUENT STARTING SEQUENCE.
• MOTOR CONTACTOR CLOSES, DRIVING PUMPING UNIT (FUEL PUMP & AIR BLOWER)
• BLOWER AIR SCAVENGES COMBUSTION CHAMBER FOR 2-3 SECONDS. FUEL BEING BY-PASSED BACK TO TANK.
• SOLENOID VALVE DIVERTS FUEL (ISO PROPYL NITRATE) TO COMBUSTION CHAMBER ATOMISER HEAD
• FUEL PRESSURE OPERATED IGNITION SWITCH CAUSES IGNITION UNIT TO ENERGISE HIGH FREQUENCY IGNITER PLUGS
• COMBUSTION CAUSES PRESSURE RISE IN FUEL LINE WHICH OPERATES H.P. SWITCH CUTTING OFF IGNITION AIR DUMP VALVE ALSO OPENED BY FUEL PRESSURE
• OPERATION OF H.P. SWITCH MAINTAINS FUEL FEED* DUMP VALVE CONTINUES EXHAUSTING AIR TO ATMOSPHERE
• EXHAUST GASES FROM COMBUSTION CHAMBER DRIVE IMPULSE TURBINE WHICH TURNS ENGINE VIA REDTN GEARING
• OVERSPEED SWITCH ON STARTER MOTOR SHUTS DOWN SYSTEM AT 12000 R.P.M. (STARTER OUTPUT)
• IN THE EVENT OF FAILURE TO START, THE TIME SWITCH IN CONTROL BOX SHUTS SYSTEM DOWN AFTER A SPECIFIC TIME
PLESSEY LIQUID FUEL STARTER SYSTEM
* IF H.P. SWITCH DOES NOT OPERATE, THEN AUTOMATIC SHUT DOWN OCCURS 0·2 SEC's AFTER IGNITION SWITCH OPERATION. WITH NON-OPERATION OF IGNITION SWITCH SHUT DOWN OCCURS ONE SEC AFTER OPERATION OF SOLENOID VALVE.
ORG REF Dol/RW 3110
PROJECT AND DEVELOPMENT ILLUSTRATION DEPT

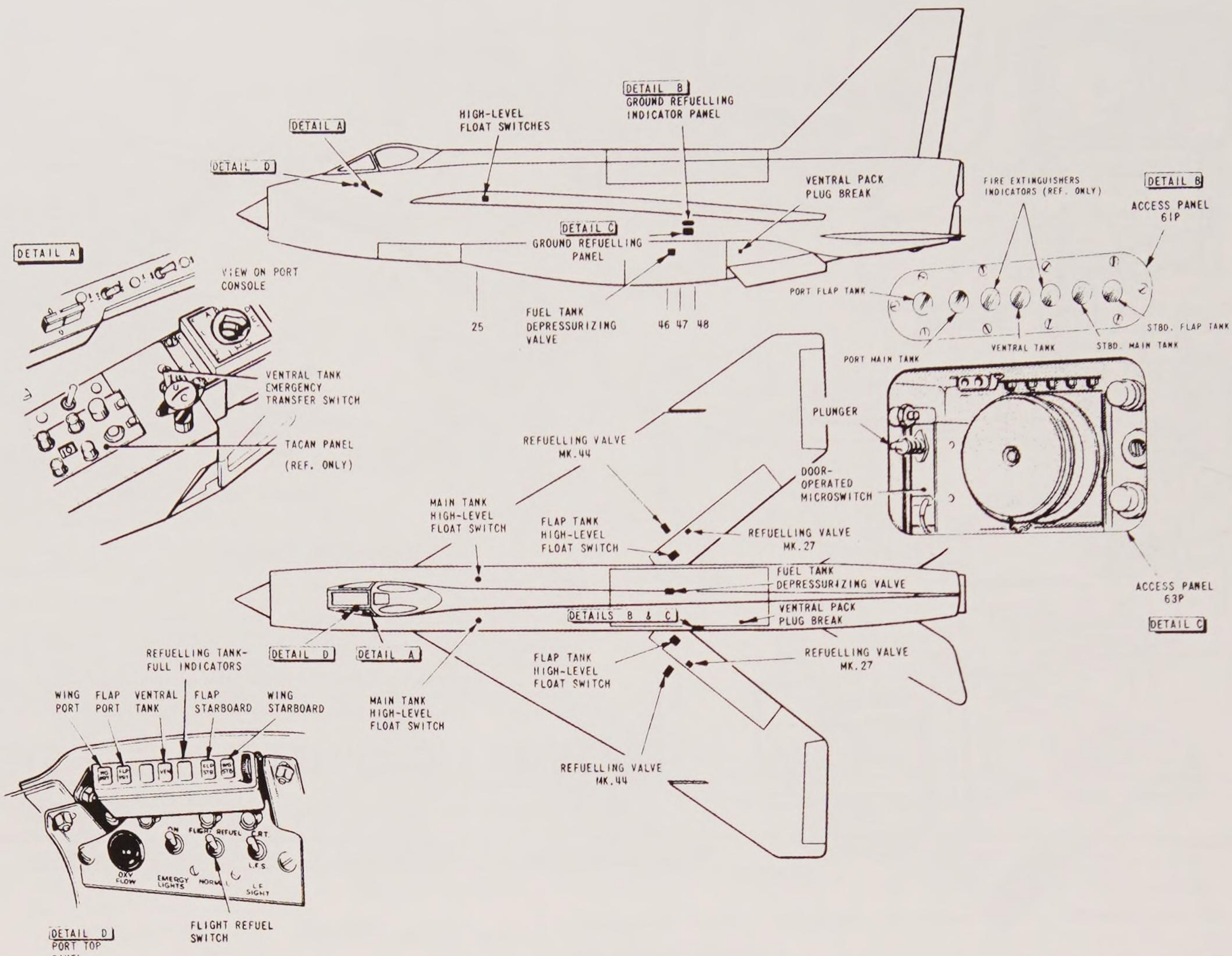
REPRODUCTION MADE WITH ACKNOWLEDGEMENT TO ROLLS ROYCE LTD. DERBY.


RELIGHT TIME-DELAY SWITCH NO.2 ENGINE
RELIGHT TIME-DELAY SWITCH NO.1 ENGINE
LOW-PRESSURE SWITCH NO.1 ENGINE
DETAIL 'B'
LOW-PRESSURE SWITCH NO.1 ENGINE
DETAIL 'C'
H.E. IGNITION UNITS NO.2 ENGINE
DETAIL 'A'
DETAIL 'C'
FRAMES
16 19 21 24 27 29 30 31 33 34 35 38 41 42
H.E. IGNITION UNITS NO.1 ENGINE
NO.1 & NO.2 ENGINE PUSH-BUTTON
DETAIL "A"
ENGINE MASTER START SWITCH
NO.1 & NO.2 ENGINE PUSH-BUTTONS
NO.1 & NO.2 ENGINE SWITCHES
DETAIL 'B'
H.E. IGNITION UNITS NO.1 ENGINE
RELIGHT TIME-DELAY SWITCH NO.1 ENGINE
DETAIL "B"
PUMP UNITS NO.1 & NO.2 ENGINE
FUSE BLOCK (ENGINE STARTING)
H.F. IGNITION UNITS NO.1 & NO.2 ENGINE
CONTROL UNITS NO.1 & NO.2 ENGINE
I.P.N. FUEL TANK
RELAYS, TYPE T2 NO.1 & NO.2 ENGINE
SOLENOID VALVE & H.P. SWITCH NO.1 & NO.2 ENGINE
RELIGHT RELAYS NO.1 & NO.2 ENGINE
RELIGHT TIME-DELAY SWITCH NO.2 ENGINE
LOW PRESSURE SWITCH NO.1 ENGINE
LOW PRESSURE SWITCH NO.2 ENGINE
H.E. IGNITION UNITS NO.2 ENGINE
SAFETY DISC
H.F. IGNITION PLUGS
OVERSPEED SWITCH
DETAIL "C"
STARTER MOTOR EQUIPMENT

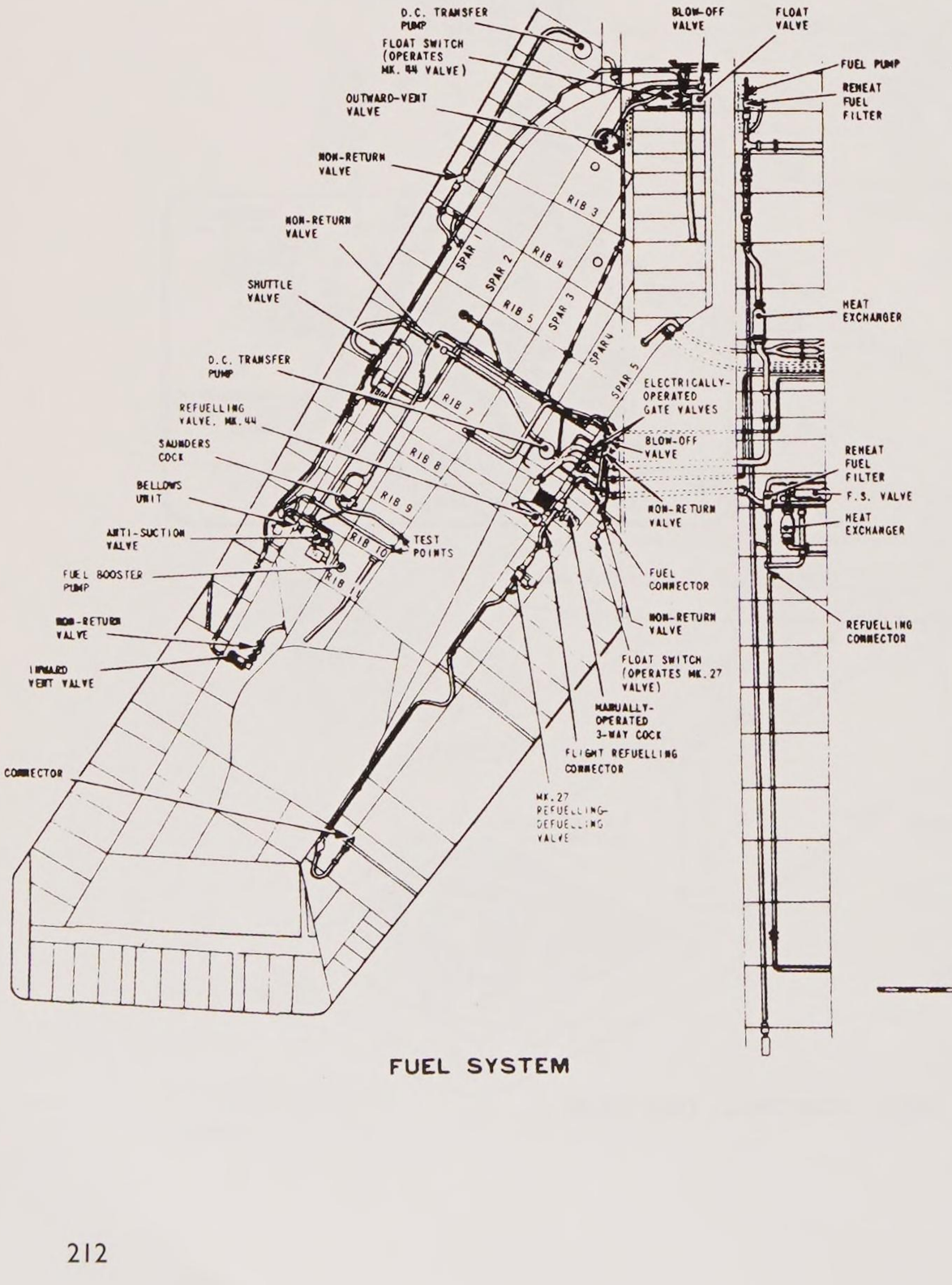
ENGINE STARTING AND CONTROL DETAILS

53-2503-1

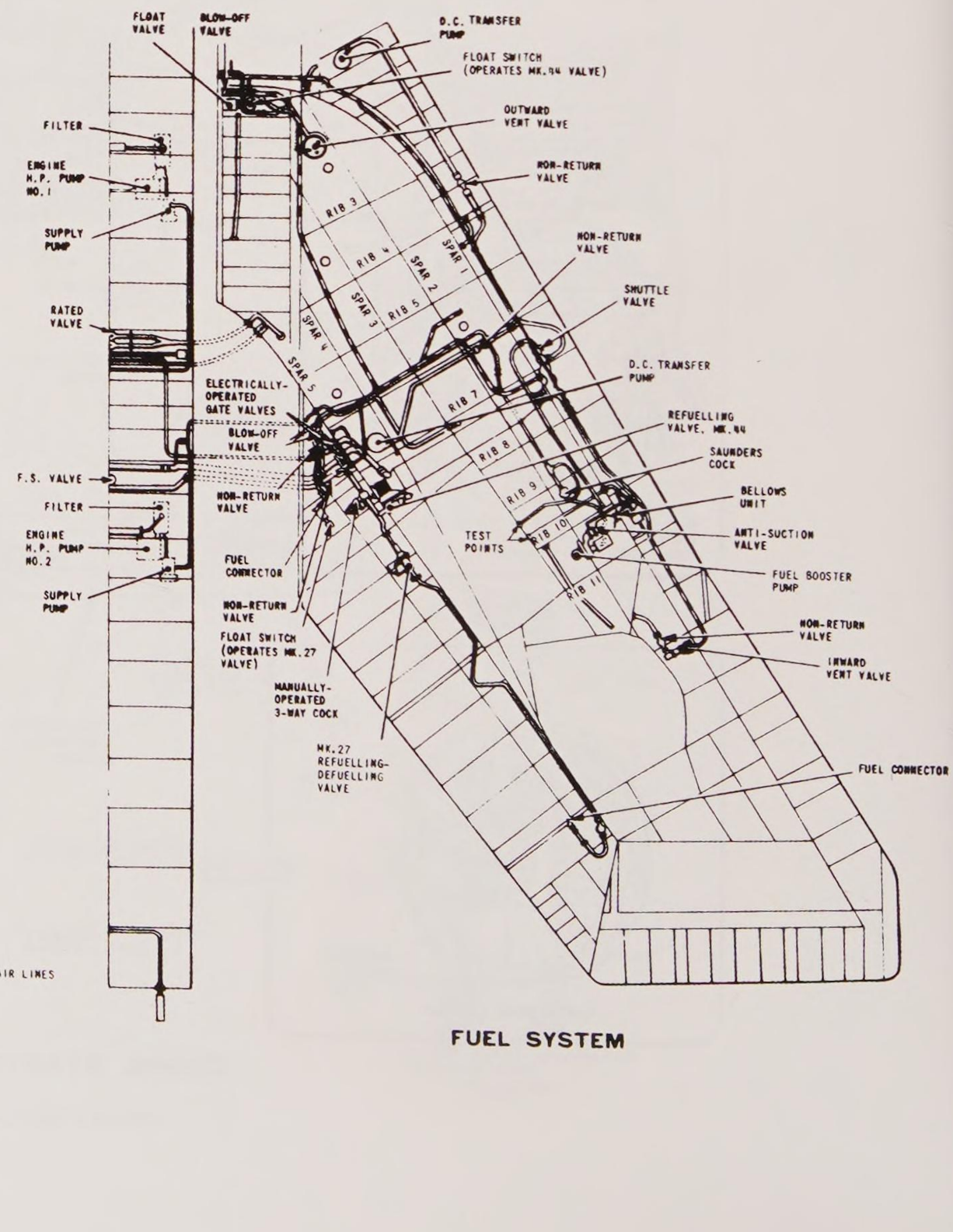
AIRCRAFT SERVICE SCHOOL
LIGHTNING
SECTION 3.



REFUELLING SYSTEM DETAILS



FUEL SYSTEM

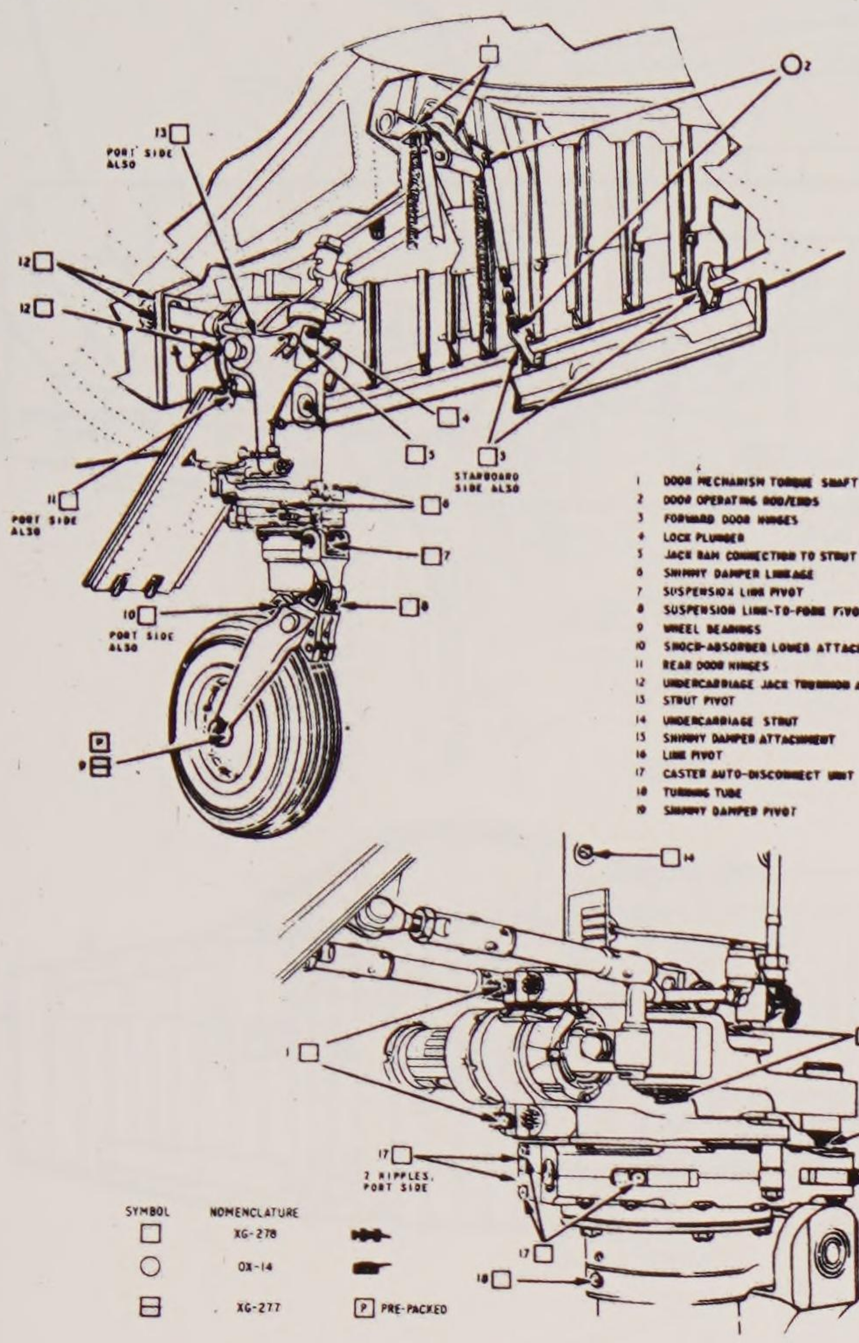


FUEL SYSTEM

TECHNICAL TRAINING SCHOOL
(SA) WARTON

LIGHTNING
AIRFRAME (A)

SECTION 3



1 DOOR MECHANISM TORQUE SHAFT
2 DOOR OPERATING ROD/ENDS
3 FORWARD DOOR HINGES
4 LOCK PLUNGER
5 JACK RAM CONNECTION TO STRUT
6 SHIMMY DAMPER LINKAGE
7 SUSPENSION LINK PIVOT
8 SUSPENSION LINK-TO-FORE PIVOT
9 WHEEL BEARINGS
10 SHOCK-ABSORBER LOWER ATTACHMENT PIN
11 REAR DOOR HINGES
12 UNDERCARRIAGE JACK TORQUE ASSEMBLY
13 STRUT PIVOT
14 UNDERCARRIAGE STRUT
15 SHIMMY DAMPER ATTACHMENT
16 LINK PIVOT
17 CASTER AUTO-DISCONNECT UNIT
18 TURNING TUBE
19 SHIMMY DAMPER PIVOT

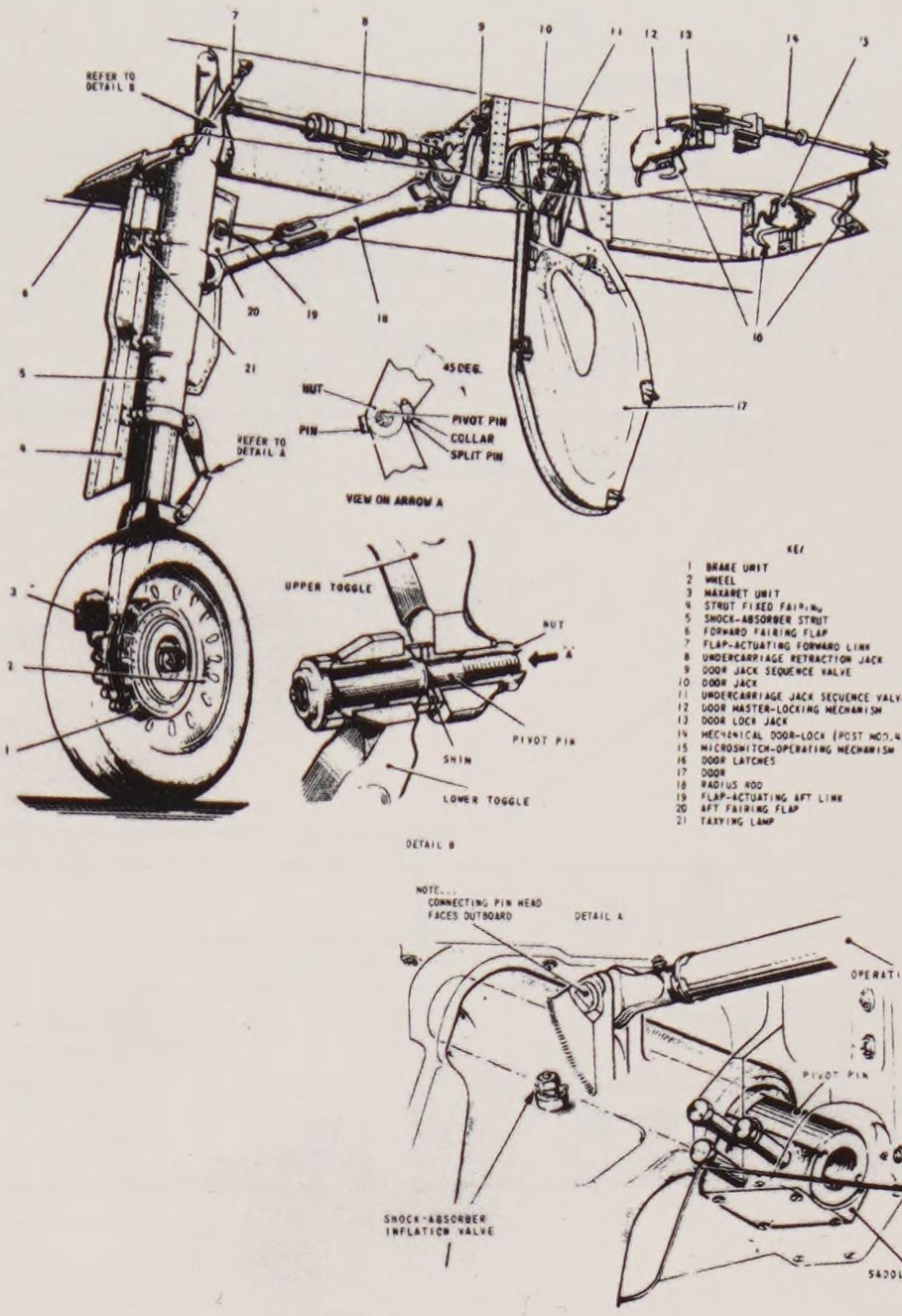
NOSE UNDERCARRIAGE LUBRICATION POINTS

CHAP. 8
PAGE 16

TECHNICAL TRAINING SCHOOL
(SA) WARTON

LIGHTNING
AIRFRAME (A)

SECTION 3

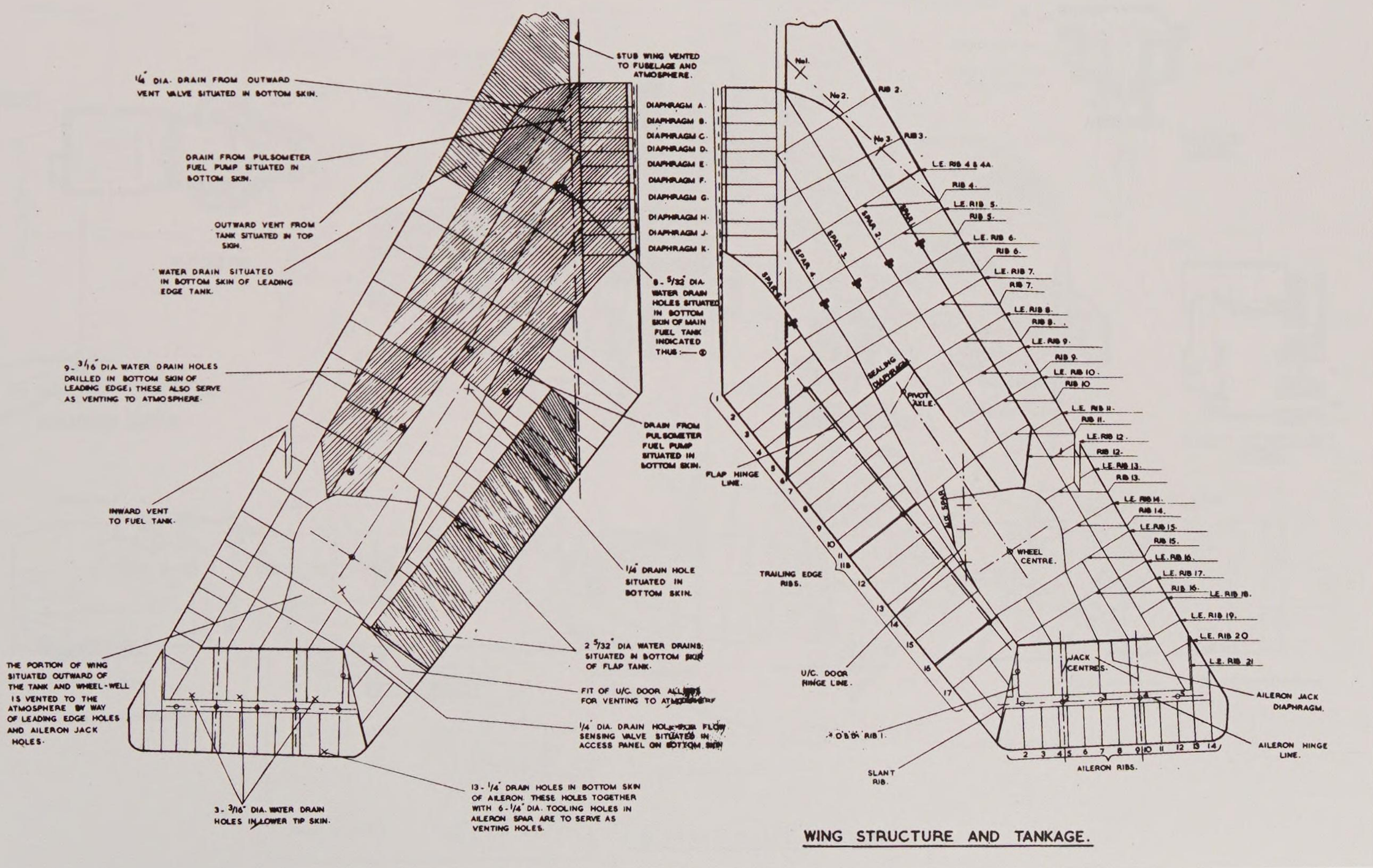


KEY

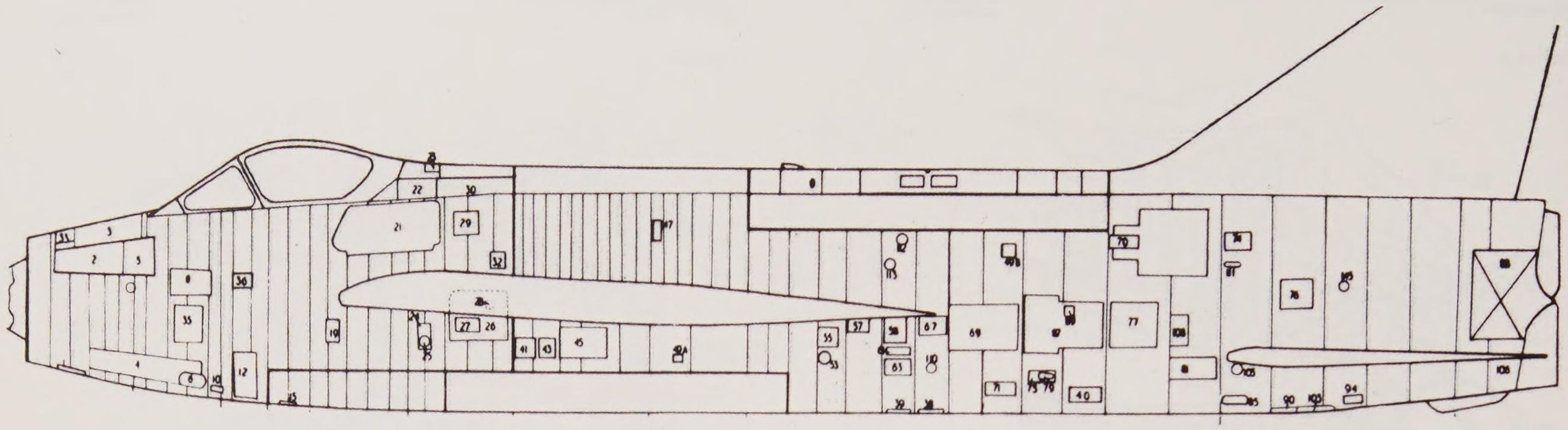
1 BRAKE UNIT
2 WHEEL
3 MAKARET UNIT
4 STRUT FIXED FAIRING
5 SHOCK-ABSORBER STRUT
6 FORWARD FAIRING FLAP
7 FLAP-ACTUATING FORWARD LINK
8 UNDERCARRIAGE RETRACTION JACK
9 DOOR JACK SEQUENCE VALVE
10 DOOR JACK
11 UNDERCARRIAGE JACK SEQUENCE VALVE
12 DOOR MASTER-LOCKING MECHANISM
13 DOOR LOCK JACK
14 MECHANICAL DOOR-LOCK (POST MOD.4211)
15 MICROSWITCH-OPERATING MECHANISM
16 DOOR LATCHES
17 DOOR
18 RADIUS ROD
19 FLAP-ACTUATING AFT LINK
20 AFT FAIRING FLAP
21 TAXYING LAMP

MAIN UNDERCARRIAGE ASSEMBY

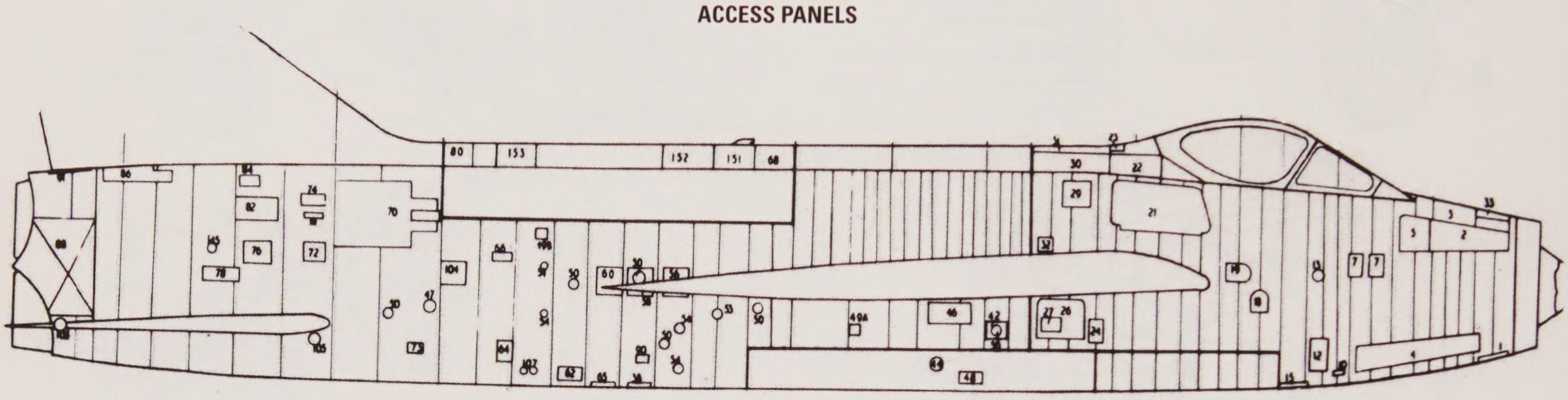
CHAP. 6
PAGE 2

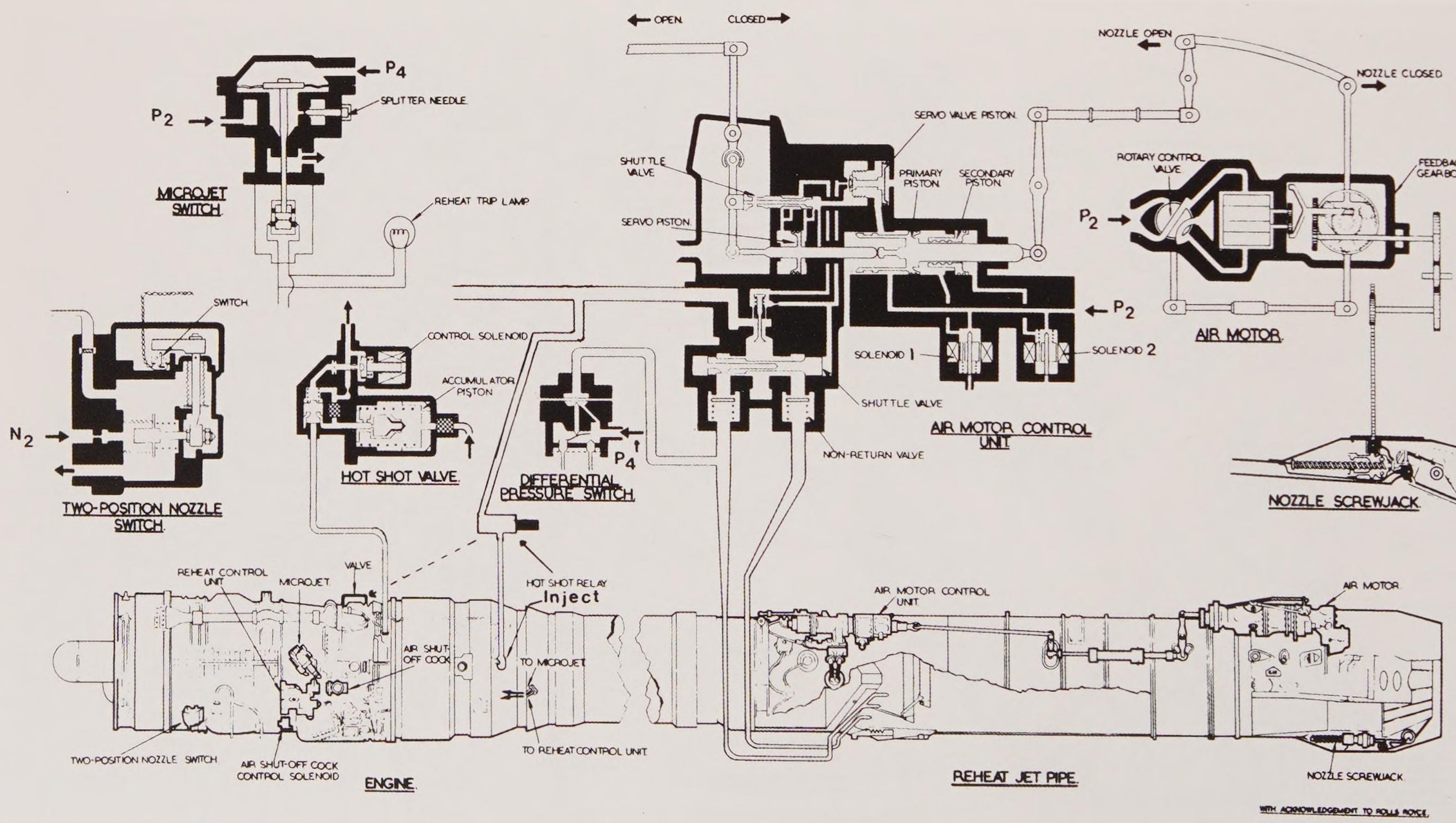

1/4" DIA. DRAIN FROM OUTWARD VENT VALVE SITUATED IN BOTTOM SKIN.
DRAIN FROM PULSOMETER FUEL PUMP SITUATED IN BOTTOM SKIN.
OUTWARD VENT FROM TANK SITUATED IN TOP SKIN.
WATER DRAIN SITUATED IN BOTTOM SKIN OF LEADING EDGE TANK.
9 - 3/16" DIA. WATER DRAIN HOLES DRILLED IN BOTTOM SKIN OF LEADING EDGE; THESE ALSO SERVE AS VENTING TO ATMOSPHERE.
INWARD VENT TO FUEL TANK.
THE PORTION OF WING SITUATED OUTWARD OF THE TANK AND WHEEL-WELL IS VENTED TO THE ATMOSPHERE BY WAY OF LEADING EDGE HOLES AND AILERON JACK HOLES.
3 - 3/16" DIA. WATER DRAIN HOLES IN LOWER TIP SKIN.
STUB WING VENTED TO FUSELAGE AND ATMOSPHERE.
DIAPHRAGM A.
DIAPHRAGM B.
DIAPHRAGM C.
DIAPHRAGM D.
DIAPHRAGM E.
DIAPHRAGM F.
DIAPHRAGM G.
DIAPHRAGM H.
DIAPHRAGM J.
DIAPHRAGM K.
8 - 5/32" DIA. WATER DRAIN HOLES SITUATED IN BOTTOM SKIN OF MAIN FUEL TANK INDICATED THUS :— ⊗
DRAIN FROM PULSOMETER FUEL PUMP SITUATED IN BOTTOM SKIN.
1/4" DRAIN HOLE SITUATED IN BOTTOM SKIN.
2 5/32" DIA WATER DRAINS SITUATED IN BOTTOM SKIN OF FLAP TANK.
FIT OF U/C. DOOR ALLOWS FOR VENTING TO ATMOSPHERE
1/4" DIA. DRAIN HOLE FOR FLOW SENSING VALVE SITUATED IN ACCESS PANEL ON BOTTOM SKIN
13 - 1/4" DRAIN HOLES IN BOTTOM SKIN OF AILERON. THESE HOLES TOGETHER WITH 6 - 1/4" DIA. TOOLING HOLES IN AILERON SPAR ARE TO SERVE AS VENTING HOLES.
No1.
No2.
No3.
RIB 2.
RIB 3.
L.E. RIB 4 & 4A.
RIB 4.
L.E. RIB 5.
RIB 5.
L.E. RIB 6.
RIB 6.
L.E. RIB 7.
RIB 7.
L.E. RIB 8.
RIB 8.
L.E. RIB 9.
RIB 9.
L.E. RIB 10.
RIB 10
L.E. RIB 11.
RIB 11.
L.E. RIB 12.
RIB 12.
L.E. RIB 13.
RIB 13.
L.E. RIB 14.
RIB 14.
L.E. RIB 15.
RIB 15.
L.E. RIB 16.
L.E. RIB 17.
RIB 16.
L.E. RIB 18.
L.E. RIB 19.
L.E. RIB 20
L.E. RIB 21
SPAR 1.
SPAR 2.
SPAR 3.
SPAR 4.
SPAR 5.
SEALING DIAPHRAGM.
PIVOT AXLE.
FLAP HINGE LINE.
WHEEL CENTRE.
TRAILING EDGE RIBS.
U/C. DOOR HINGE LINE.
JACK CENTRES.
AILERON JACK DIAPHRAGM.
AILERON HINGE LINE.
RIB 1.
SLANT RIB.
AILERON RIBS.

WING STRUCTURE AND TANKAGE.

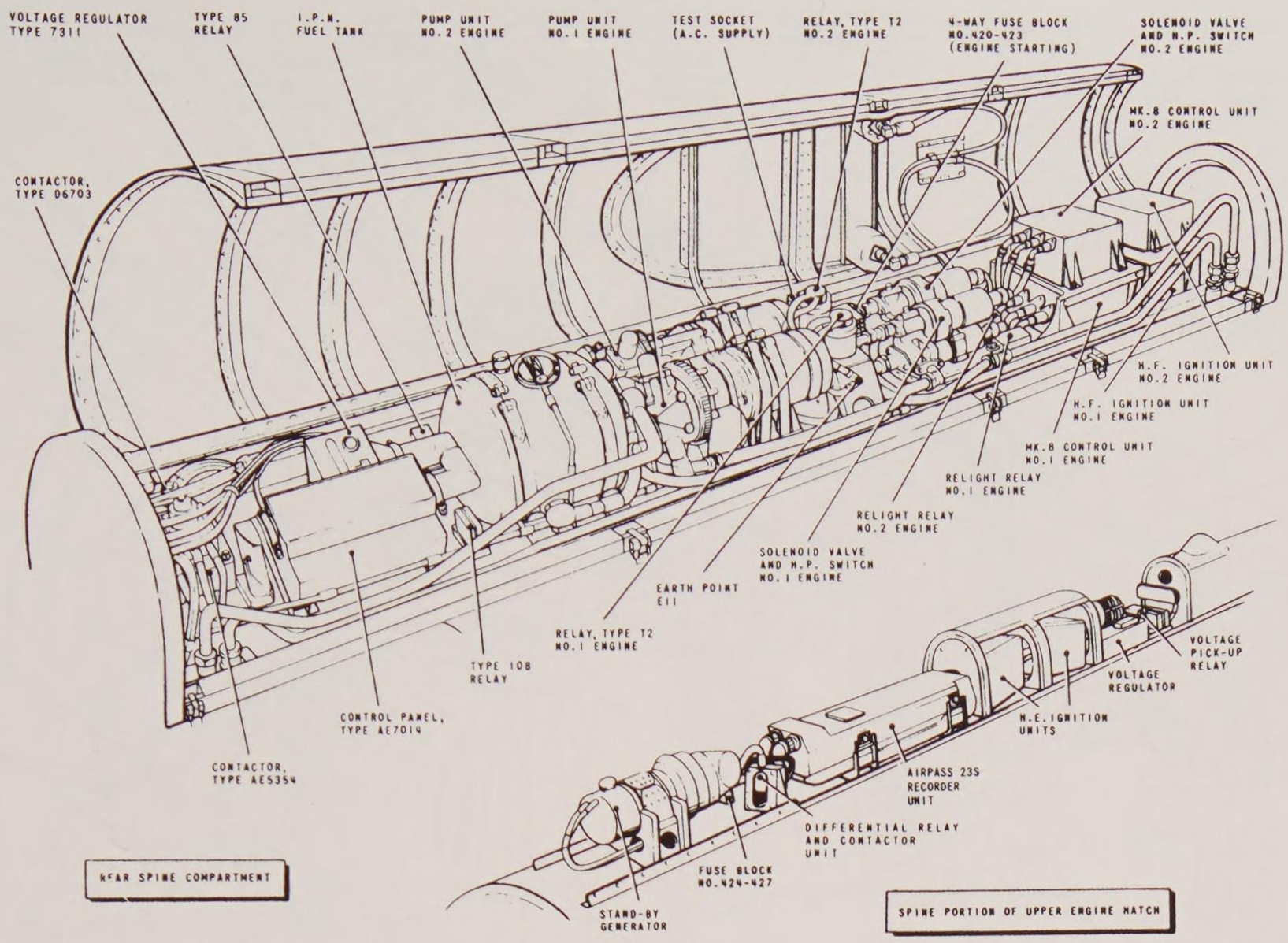


ACCESS PANELS

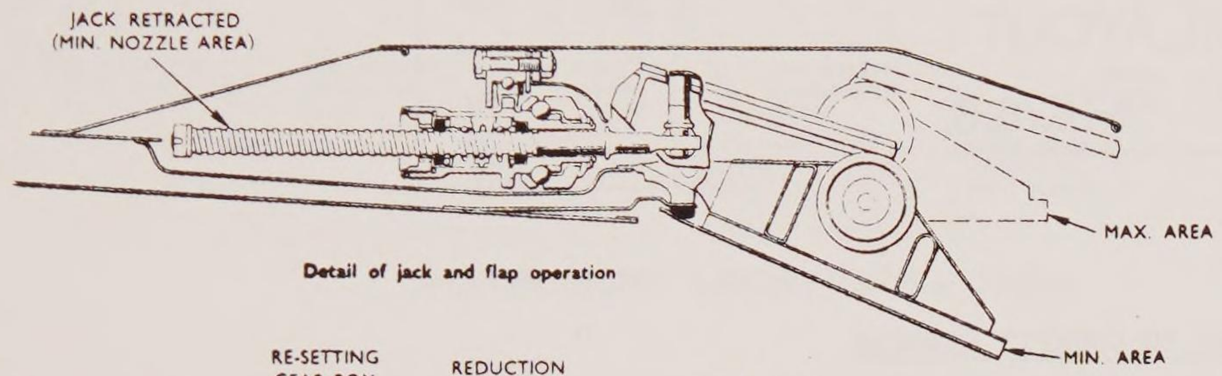




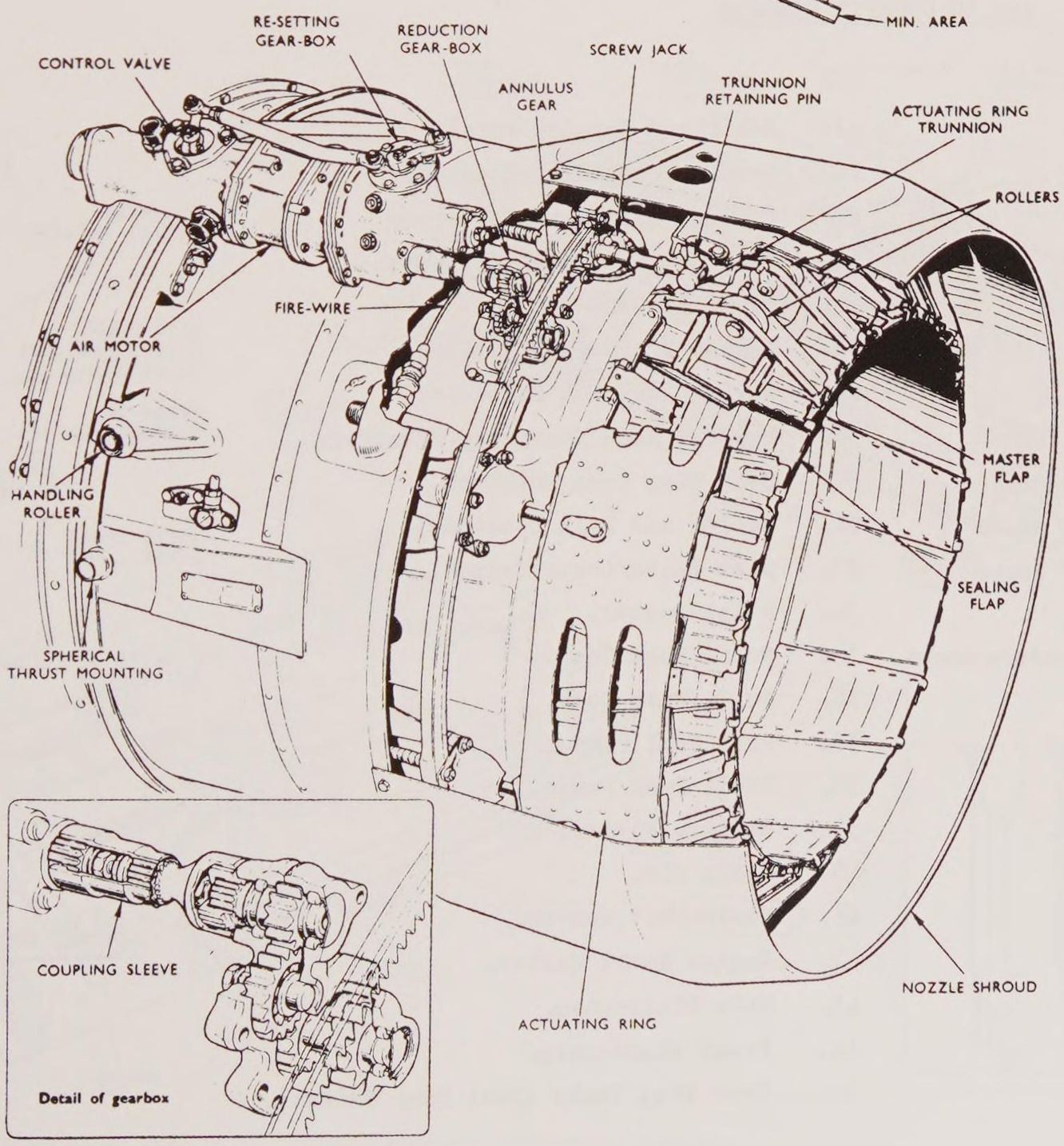
REHEAT FUEL SYSTEM 2


VOLTAGE REGULATOR TYPE 7311
TYPE 85 RELAY
I.P.N. FUEL TANK
PUMP UNIT NO. 2 ENGINE
PUMP UNIT NO. 1 ENGINE
TEST SOCKET (A.C. SUPPLY)
RELAY, TYPE T2 NO. 2 ENGINE
4-WAY FUSE BLOCK NO. 420-423 (ENGINE STARTING)
SOLENOID VALVE AND H.P. SWITCH NO. 2 ENGINE
MK. 8 CONTROL UNIT NO. 2 ENGINE
CONTACTOR, TYPE D6703
H.F. IGNITION UNIT NO. 2 ENGINE
H.F. IGNITION UNIT NO. 1 ENGINE
MK. 8 CONTROL UNIT NO. 1 ENGINE
RELIGHT RELAY NO. 1 ENGINE
RELIGHT RELAY NO. 2 ENGINE
SOLENOID VALVE AND H.P. SWITCH NO. 1 ENGINE
EARTH POINT E11
RELAY, TYPE T2 NO. 1 ENGINE
TYPE 108 RELAY
CONTROL PANEL, TYPE AE7014
CONTACTOR, TYPE AE5354
REAR SPINE COMPARTMENT
VOLTAGE PICK-UP RELAY
VOLTAGE REGULATOR
H.E. IGNITION UNITS
AIRPASS 23S RECORDER UNIT
DIFFERENTIAL RELAY AND CONTACTOR UNIT
FUSE BLOCK NO. 424-427
STAND-BY GENERATOR
SPINE PORTION OF UPPER ENGINE HATCH

EQUIPMENT LOCATION DETAILS



Detail of jack and flap operation



Detail of gearbox

PROPELLING NOZZLE

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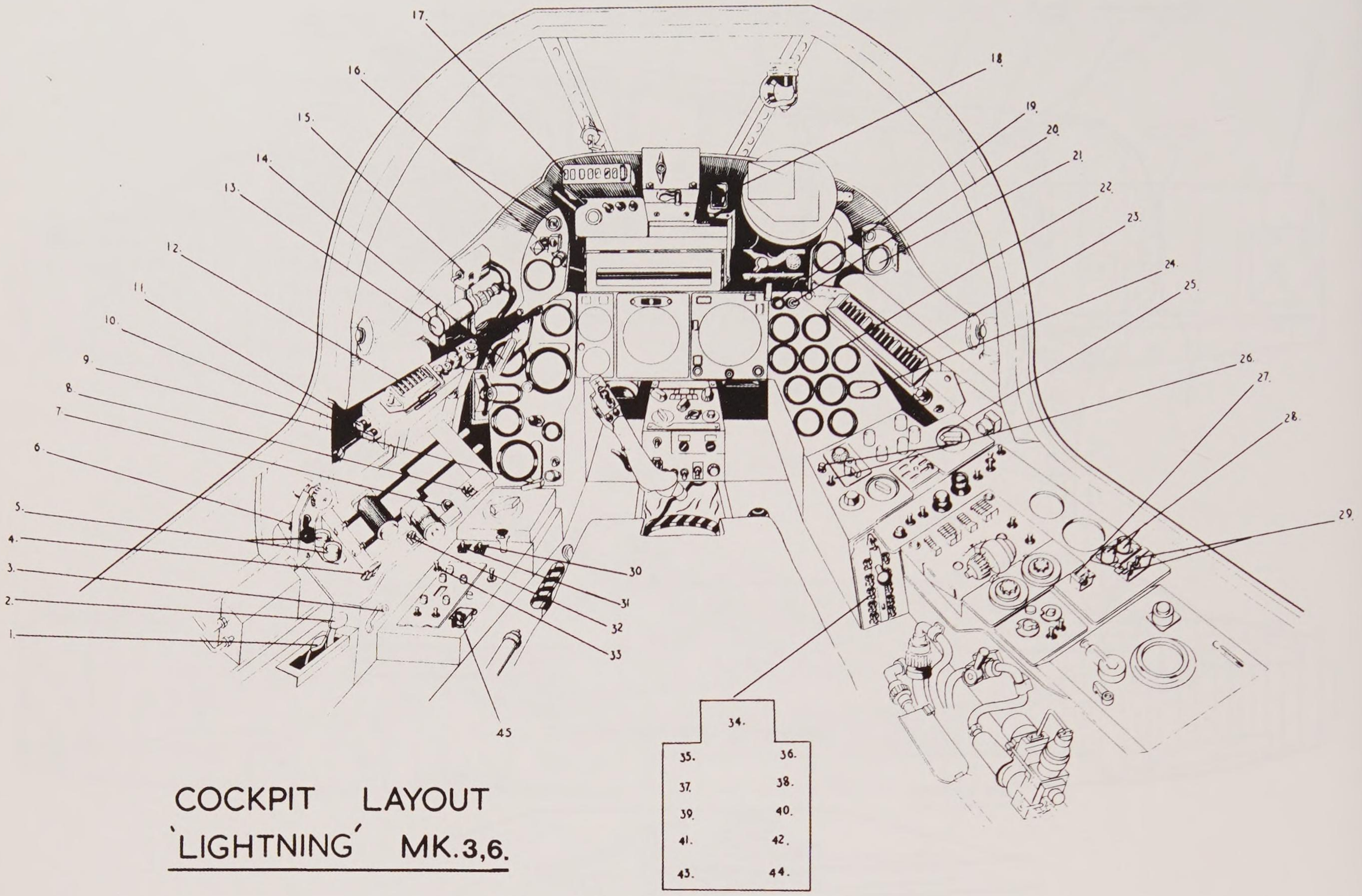
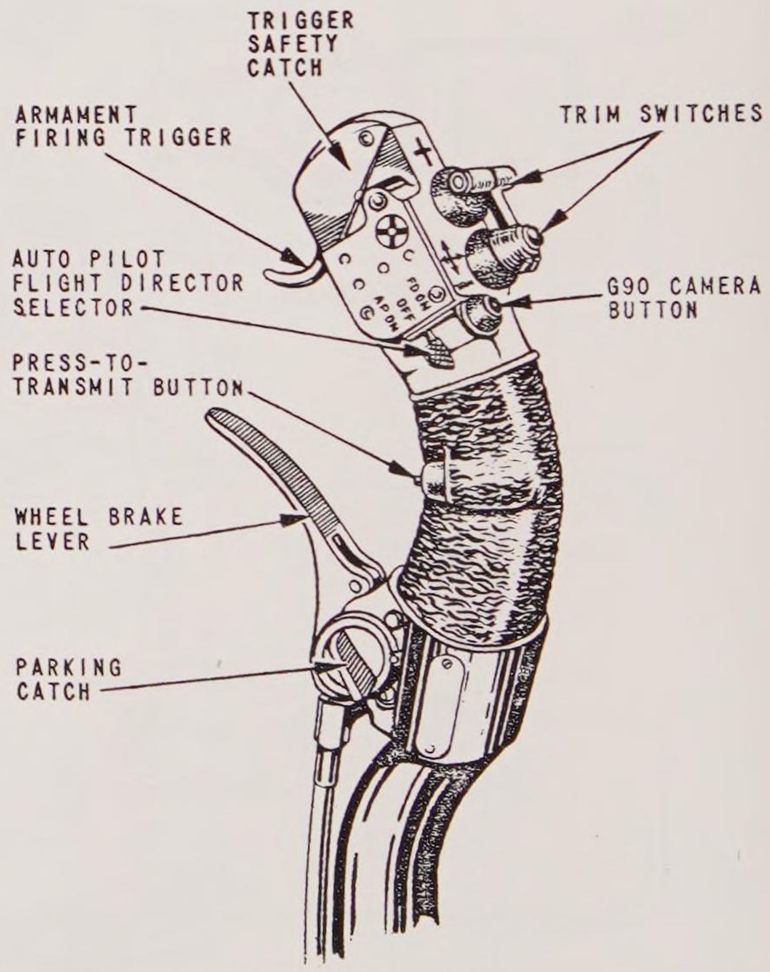


COCKPIT LAYOUT
'LIGHTNING' MK.3,6.

KEY TO COCKPIT DIAGRAM

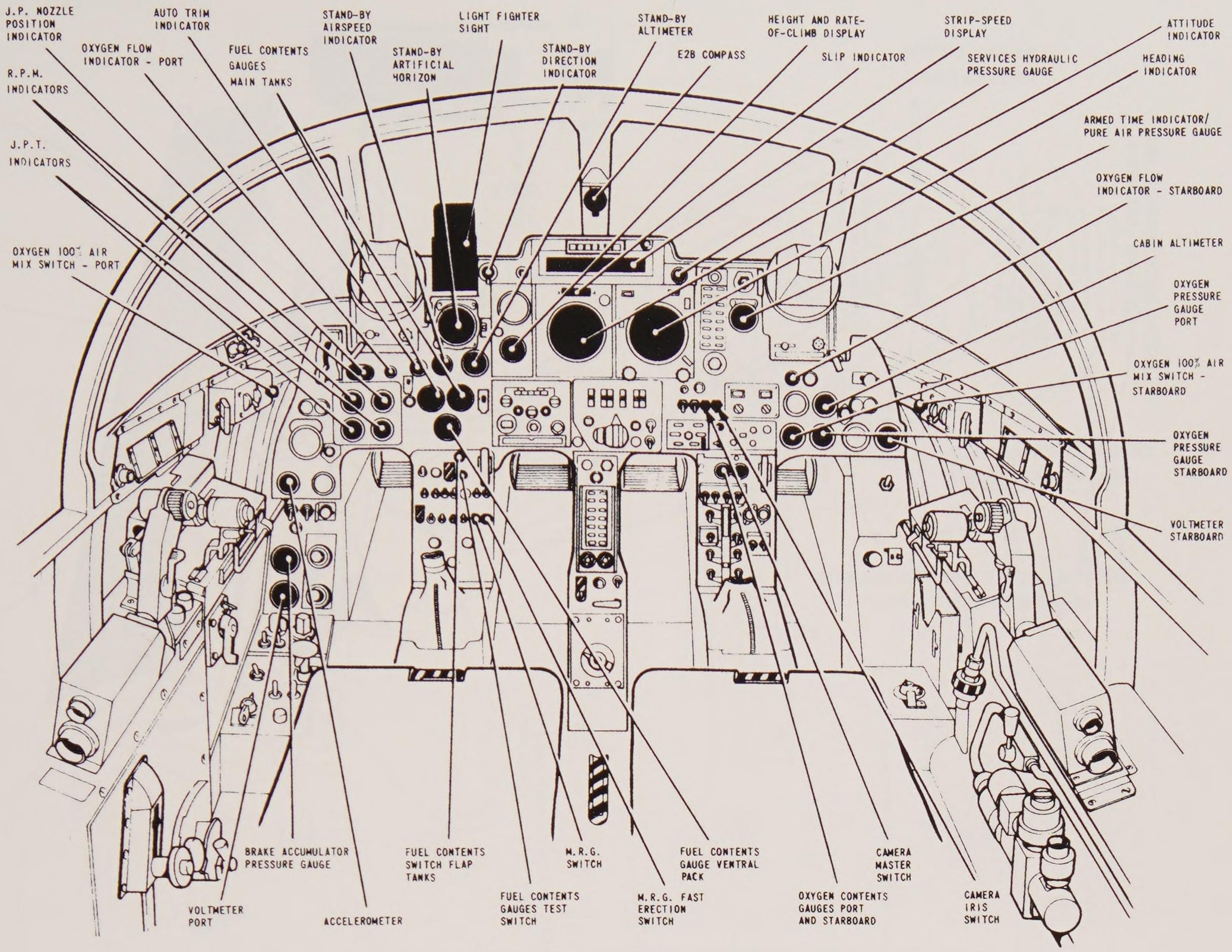
1. Emergency Air Valve.
2. Demist Control Lever.
3. Servo Clutch Lever.
4. Rudder Trim.
5. Relight Buttons.
6. J.P.T. Control Switches.
7. De-Ice On Indicator.
8. Feel.
9. Vental Tank and Missile Jettison.
10. Fire Warning and Extinguisher No.2.
11. Fire Warning and Extinguisher No.1.
12. Critical Warning Panel.
13. Services Hydraulic System Pressure Gauge.
14. Brake Pressure Gauge.
15. Flight Refuel/Test.
16. Invertor P/E and Switch.
17. Flight Refuel Indicator Panel.
18. Attention Getter.
19. Fuel Transfer Light.
20. Fuel Transfer Switch.
21. D.C. Voltmeter.
22. Fuel Contents.
23. Auxiliary Warning Panel.
24. Nozzle Position Indicator.
25. Cabin Temperature Selector.
26. Fuel Contents Test Switches.
27. Stand By Generator.
28. Engine Start Push Buttons.
29. Engine Ignition Switches.
30. Ventral Tank Emergency Transfer.
31. Over Wing Tank Jettison.
32. De-Ice and Rain Dispersal.
33. Seat Raise/Lower Switch.
34. Pitot Heater.
35. No.1. Fuel Cock.
36. No.2. Fuel Cock.
37. Port Fuel Pumps.
38. Stbd. Fuel Pumps.
39. Battery Master.
40. Cabin Air.
41. Instrument Master.
42. Engine Start Master.
43. Side Windscreen.
44. Front Windscreen.
45. Over Wing Tanks (Fuel Dump Switch).

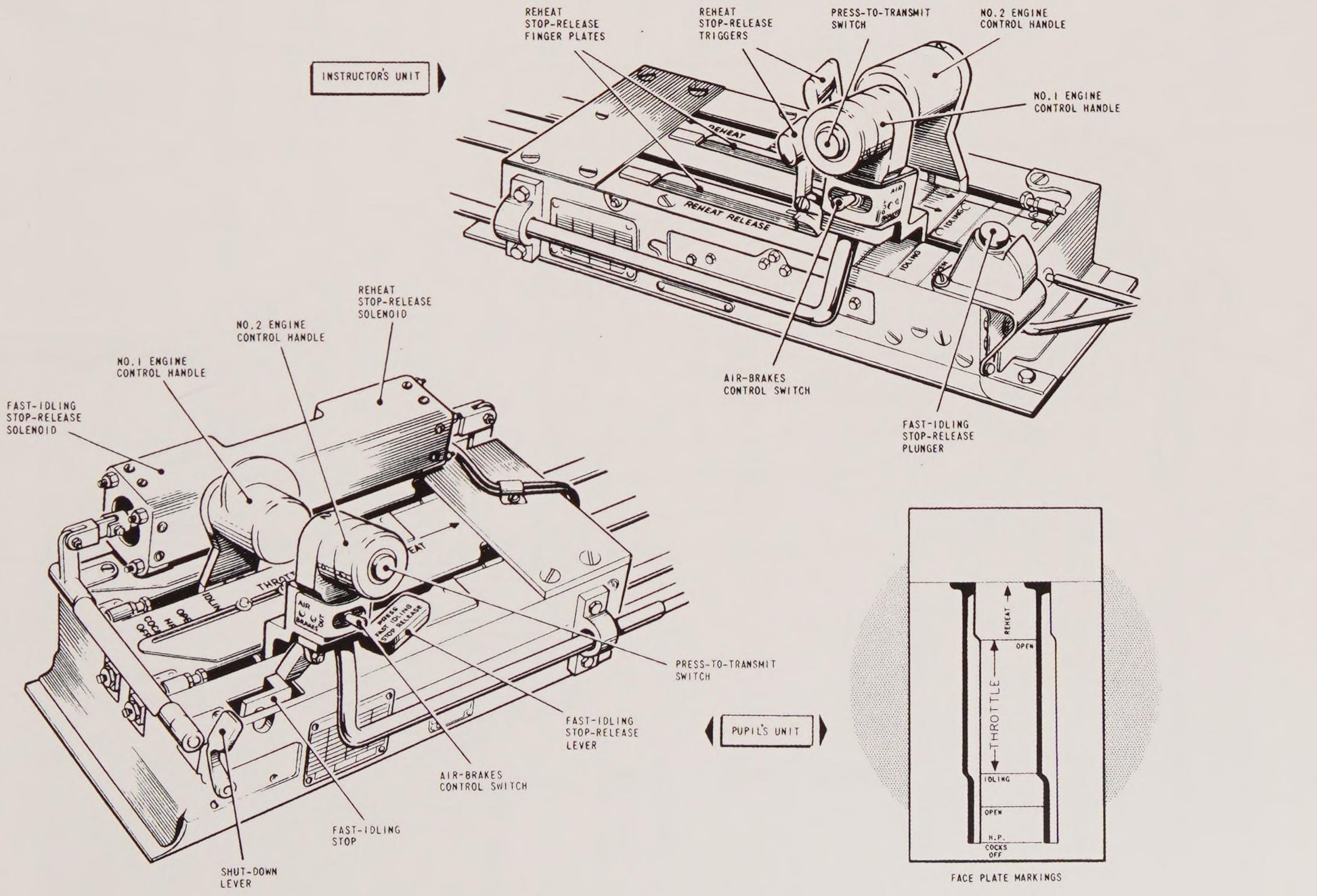


CONTROL COLUMN HANDLE.

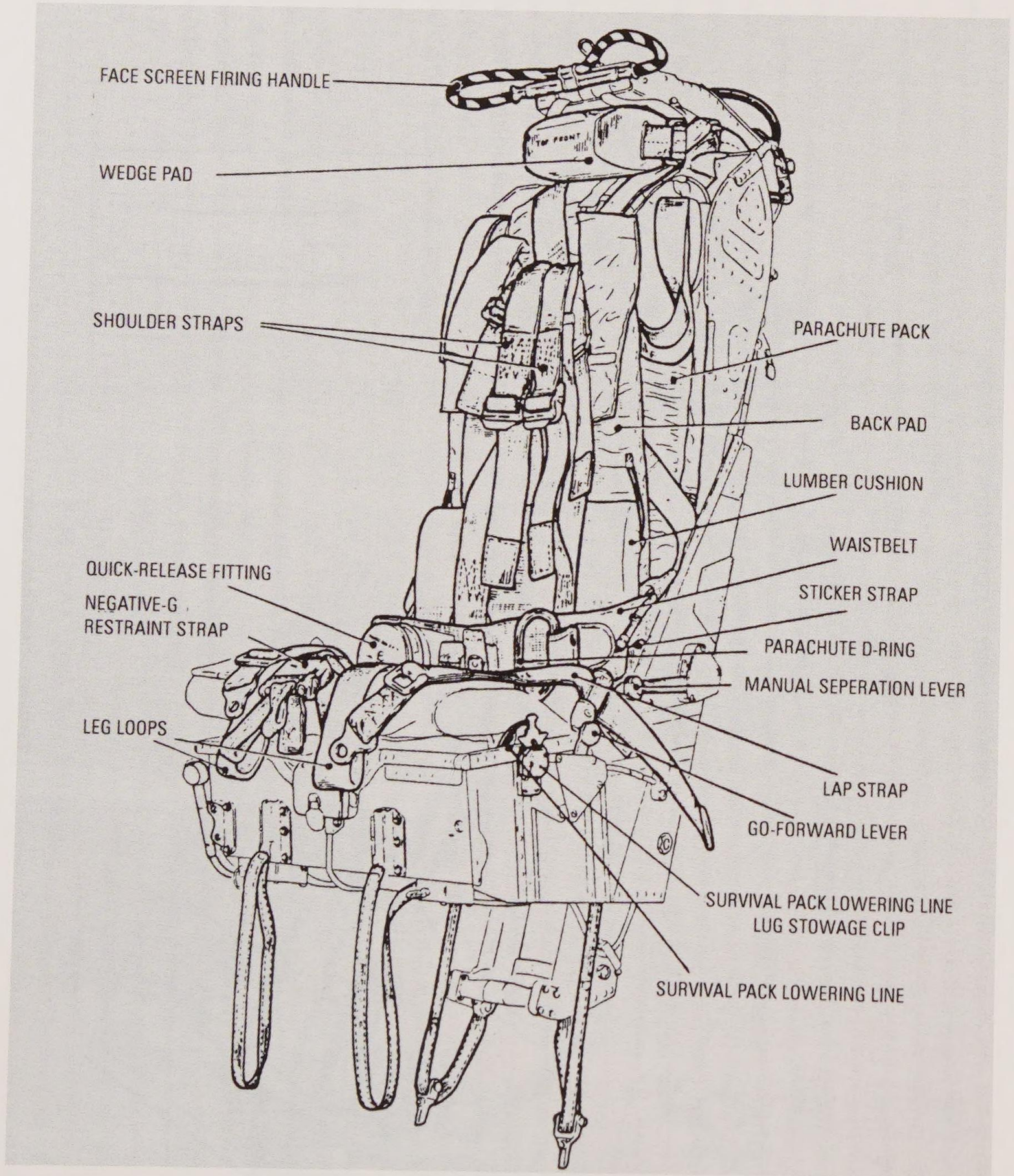
INSTRUMENT LOCATIONS - CABIN

55-2533-1





ENGINE CONTROL UNITS



Martin Baker Mk.4 ejection seat as fitted to the Lightning. (Martin Baker)

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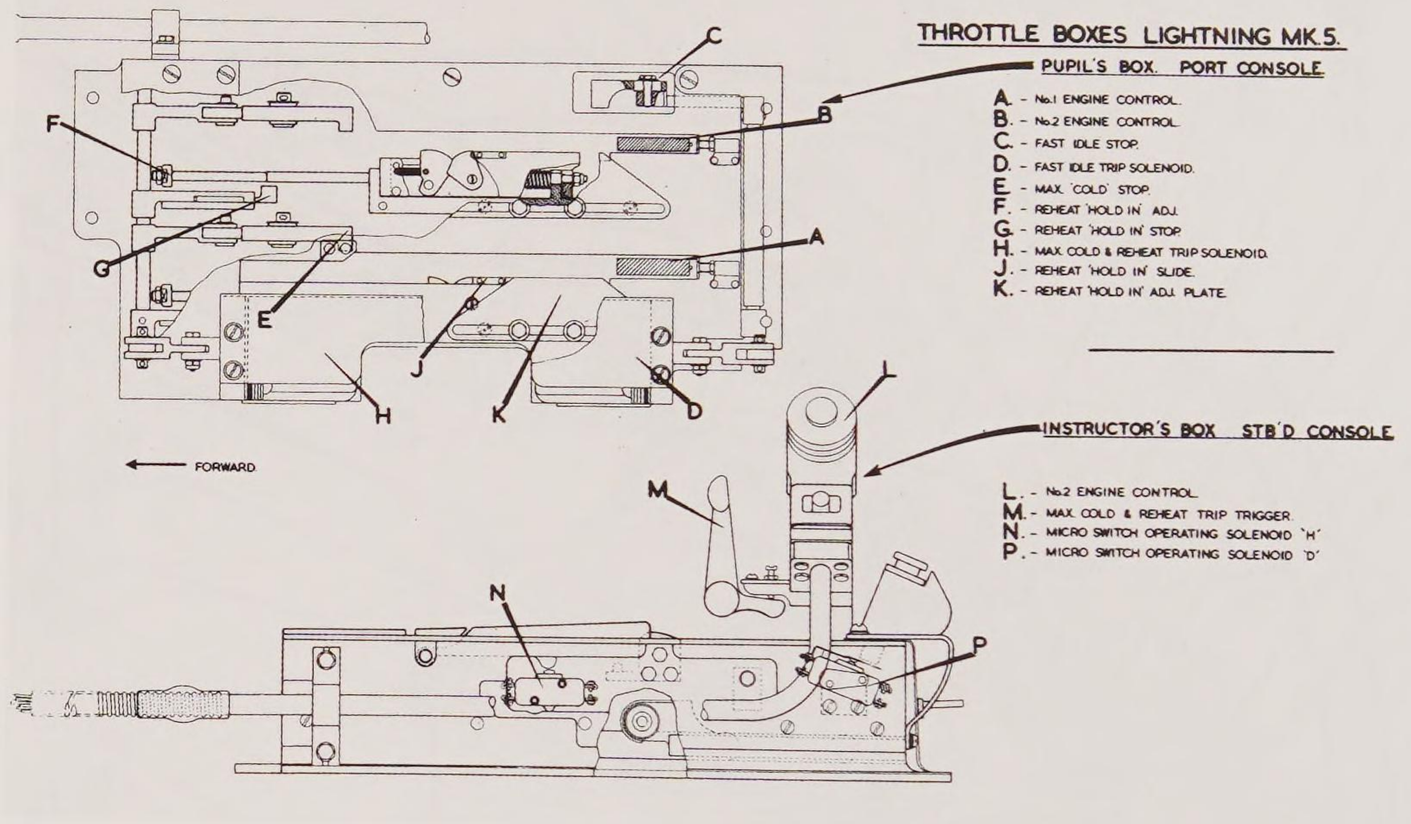
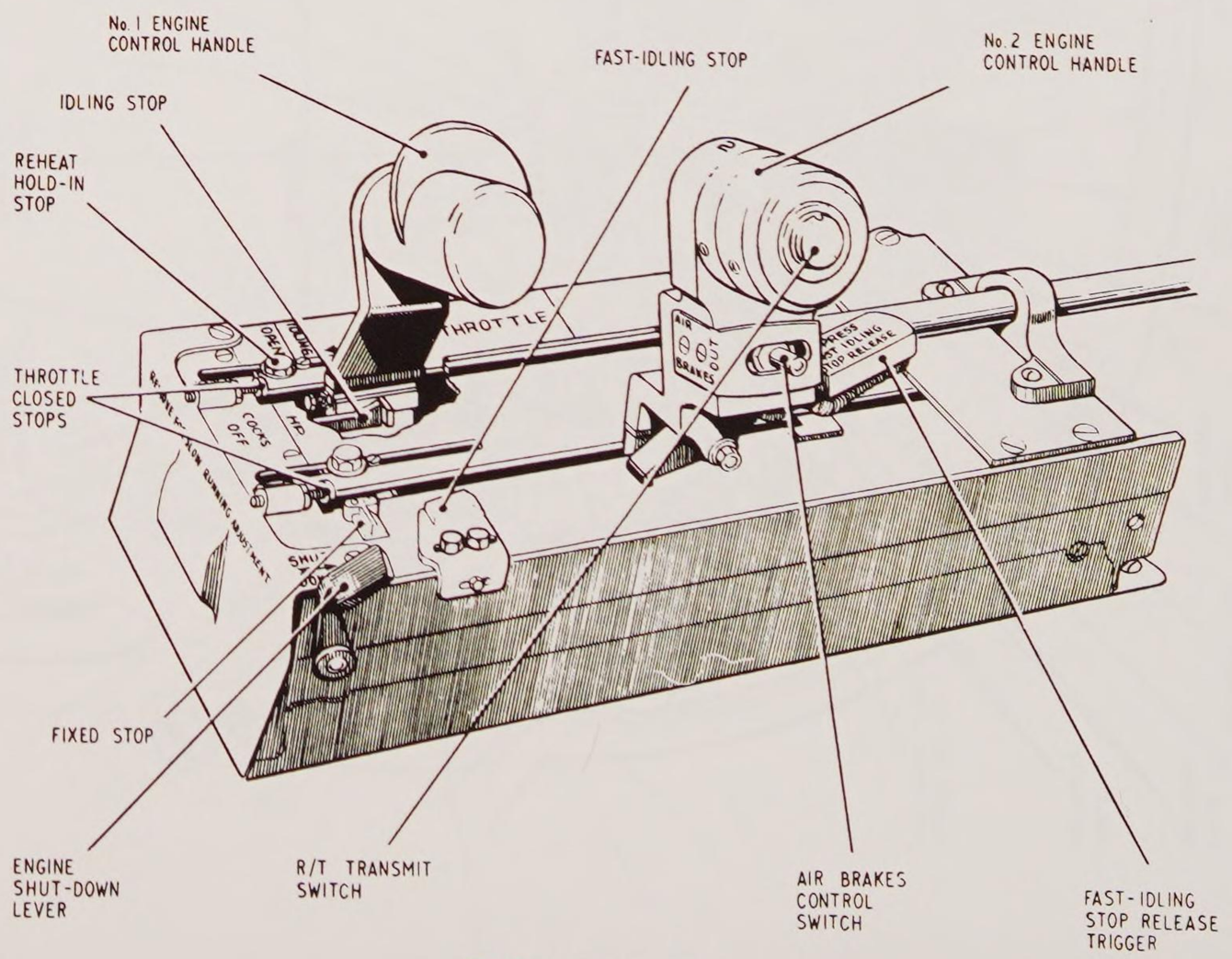
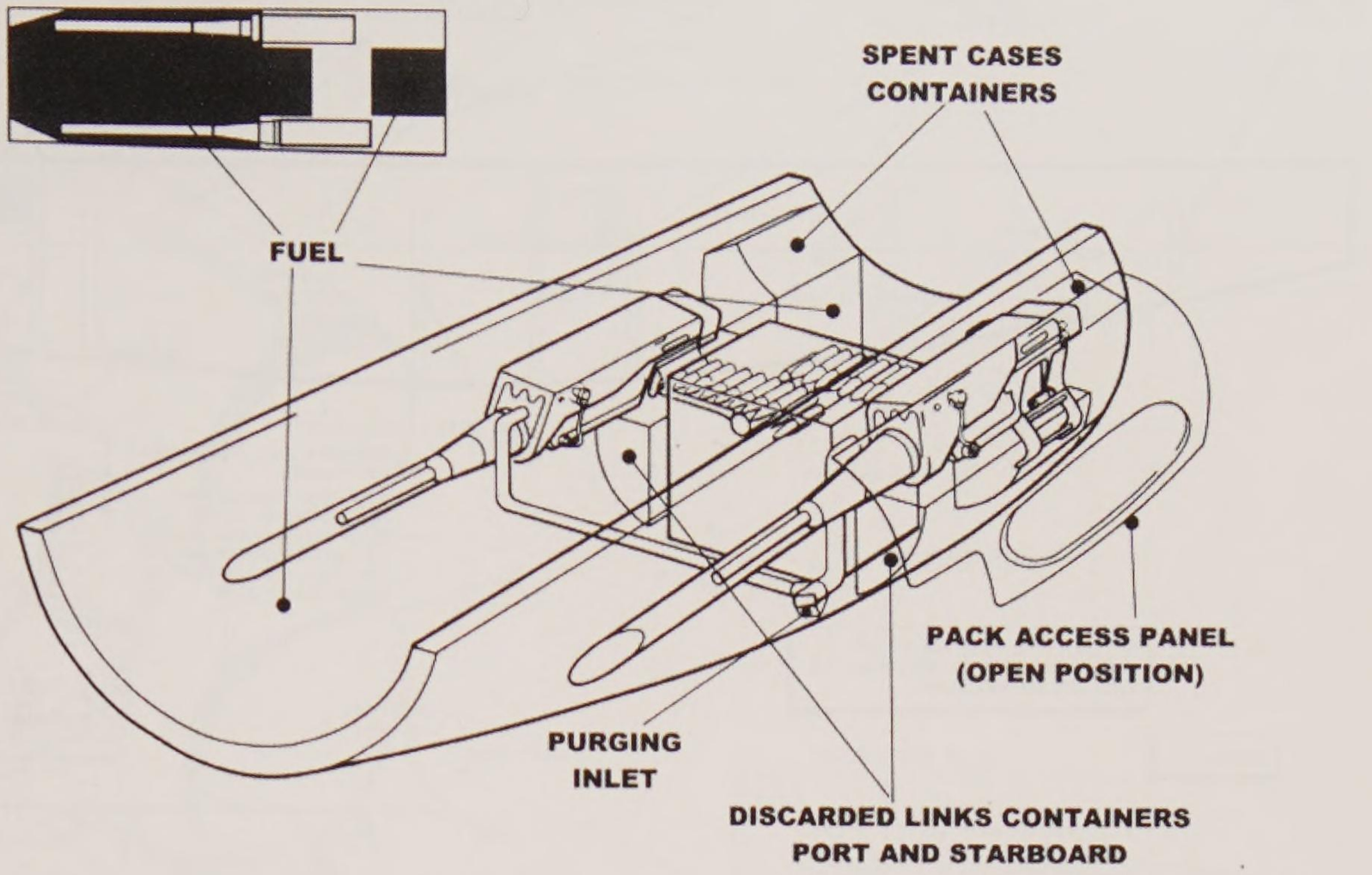
AIRCRAFT SERVICING SCHOOL
SUPPLEMENT Mk.5

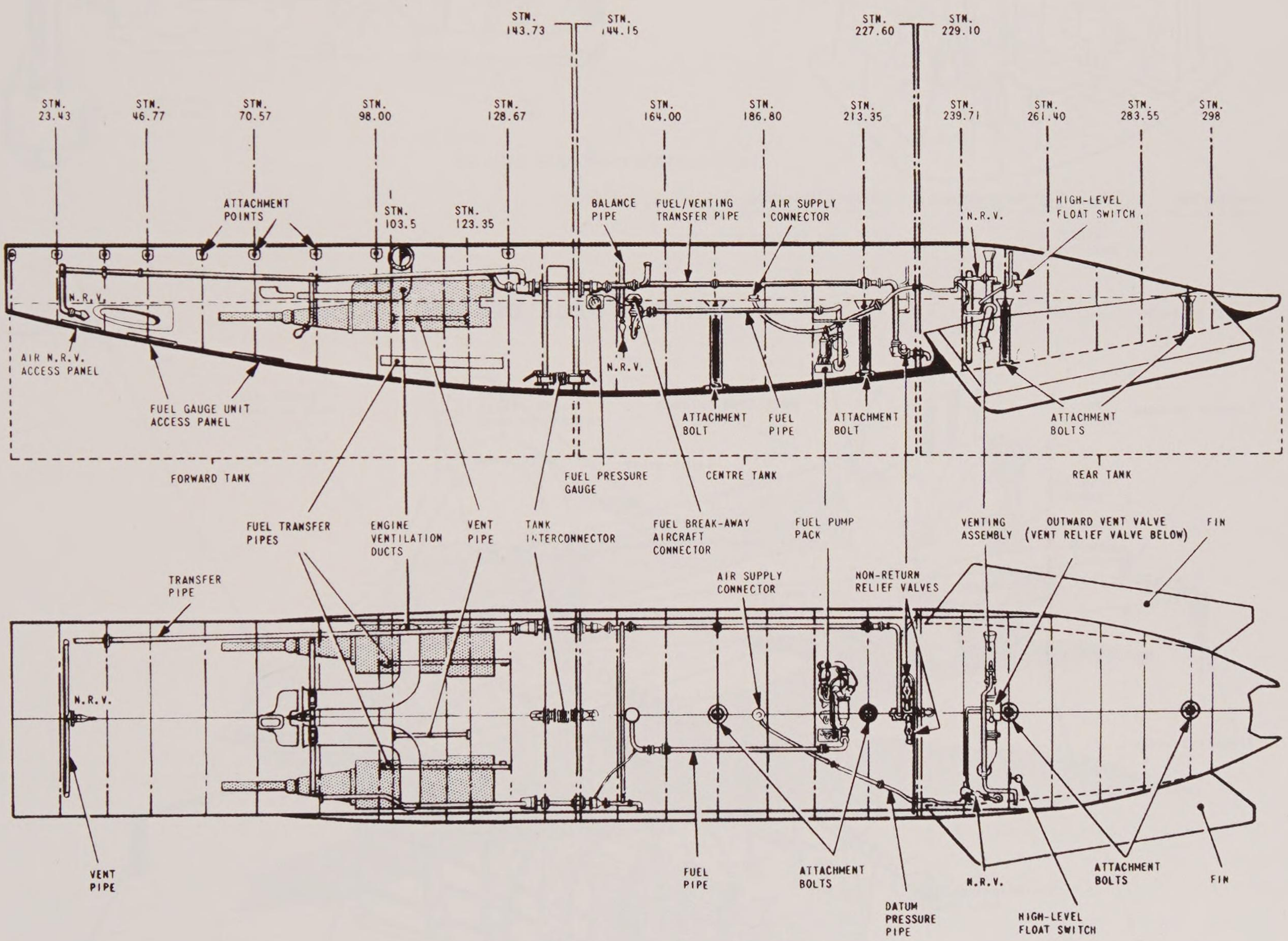

THROTTLE BOXES LIGHTNING MK.5.
PUPIL'S BOX. PORT CONSOLE
A. - No.1 ENGINE CONTROL.
B. - No.2 ENGINE CONTROL.
C. - FAST IDLE STOP.
D. - FAST IDLE TRIP SOLENOID.
E. - MAX. 'COLD' STOP.
F. - REHEAT 'HOLD IN' ADJ.
G. - REHEAT 'HOLD IN' STOP.
H. - MAX. COLD & REHEAT TRIP SOLENOID.
J. - REHEAT 'HOLD IN' SLIDE.
K. - REHEAT 'HOLD IN' ADJ. PLATE.
INSTRUCTOR'S BOX STB'D CONSOLE
L. - No.2 ENGINE CONTROL.
M. - MAX. COLD & REHEAT TRIP TRIGGER.
N. - MICRO SWITCH OPERATING SOLENOID 'H'
P. - MICRO SWITCH OPERATING SOLENOID 'D'
FORWARD

LIGHTNING
E.N 2.



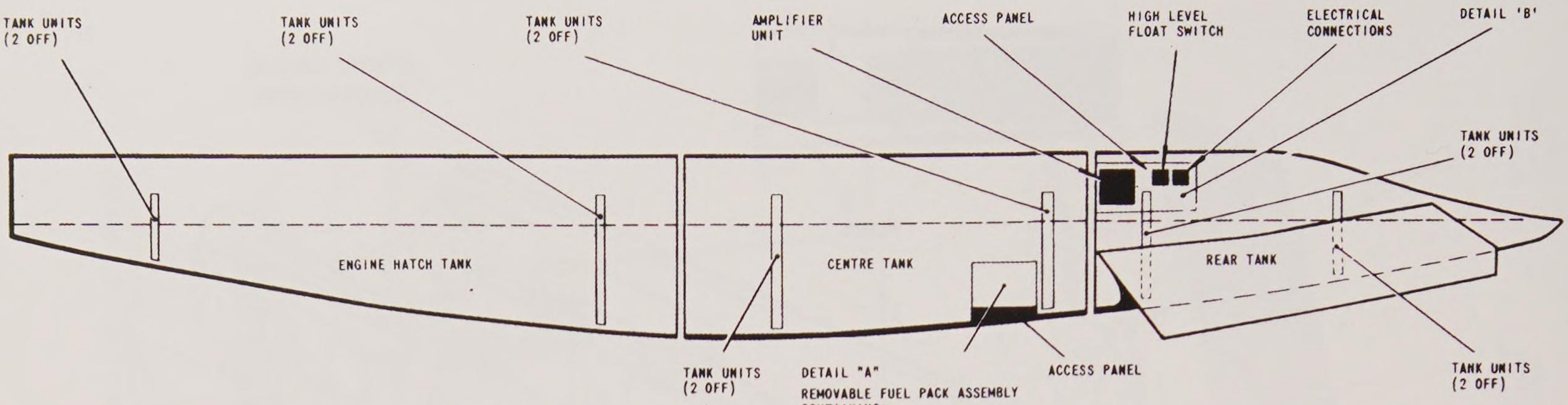
THROTTLE BOX.





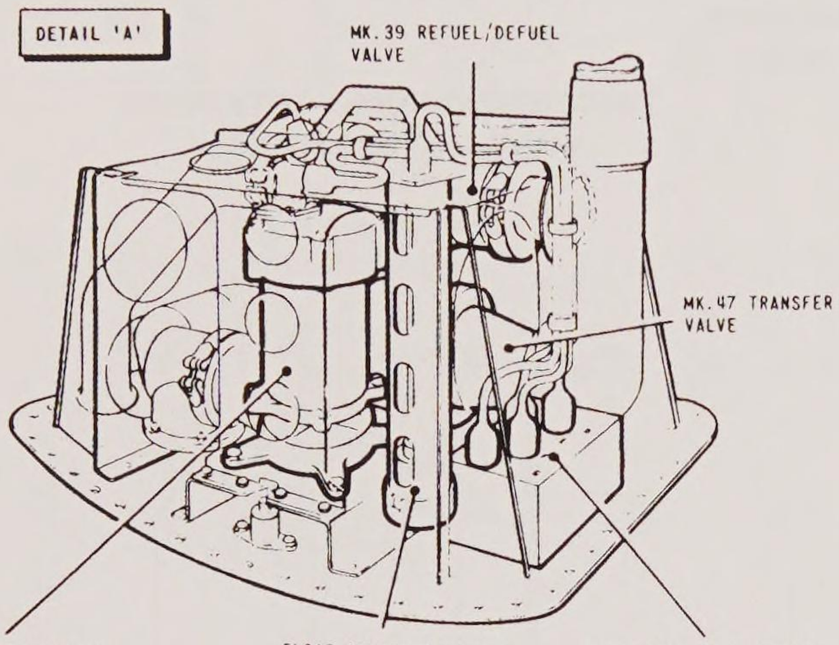
VENTRAL PACK (WITH GUNS)

53-2218-2



TO CLARIFY THE LOCATION OF THE COMPONENTS, PARTS OF THE SUPPORTING STRUCTURE ARE NOT SHOWN

DETAIL 'A'

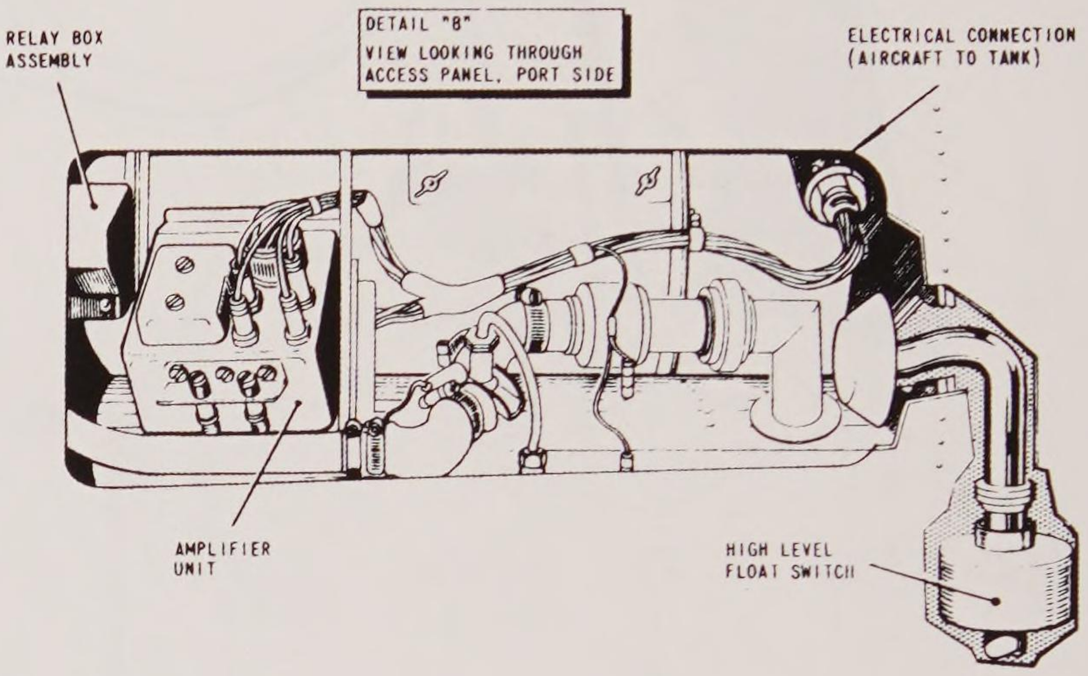


TRANSFER PUMP
TYPE F.T.P.102

FLOAT SWITCH ASSEMBLY
PART NO.355000/70

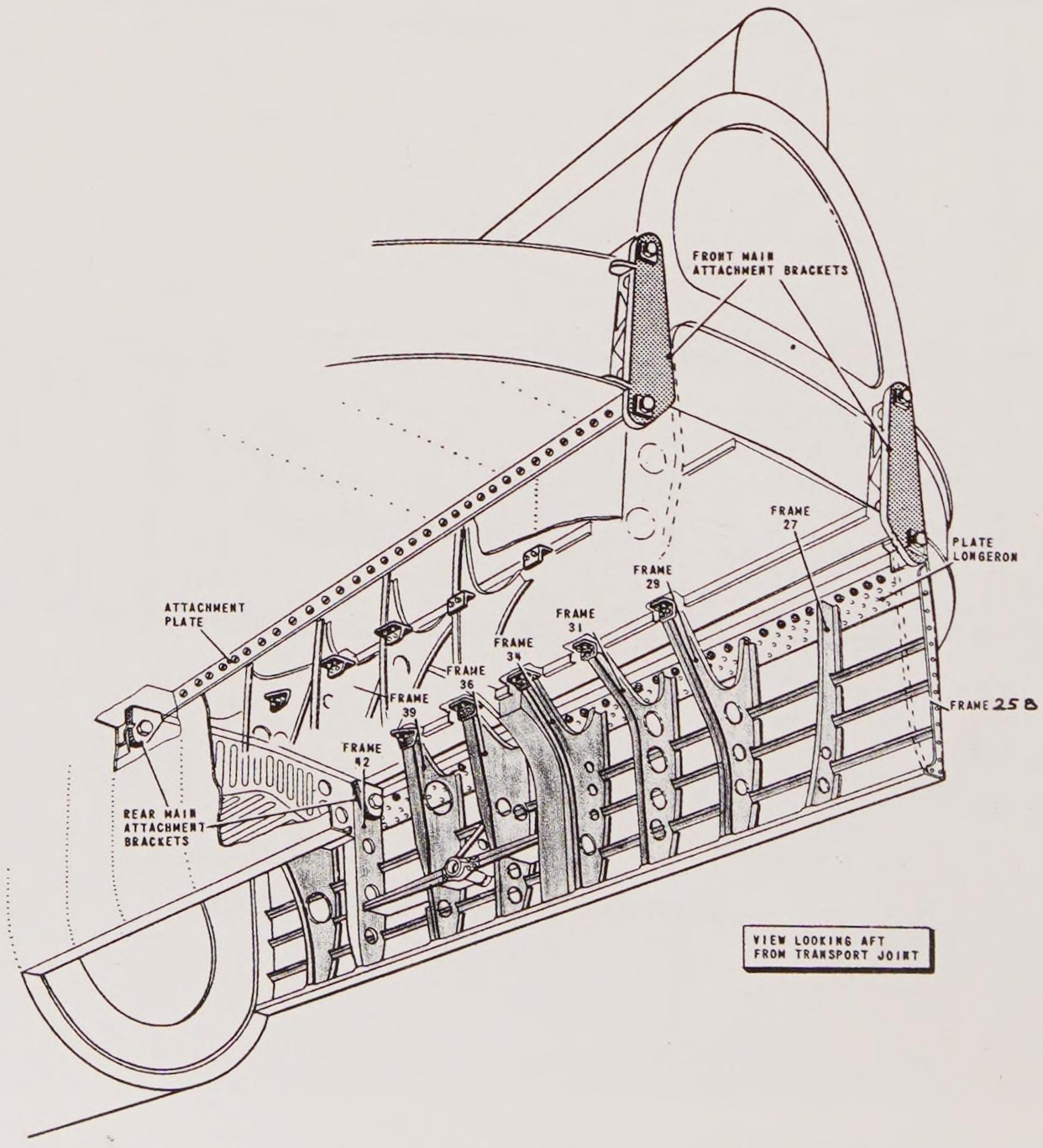
ELECTRICAL CONNECTIONS
(ACCESS FROM UNDERSIDE)

DETAIL "B"
VIEW LOOKING THROUGH ACCESS PANEL, PORT SIDE

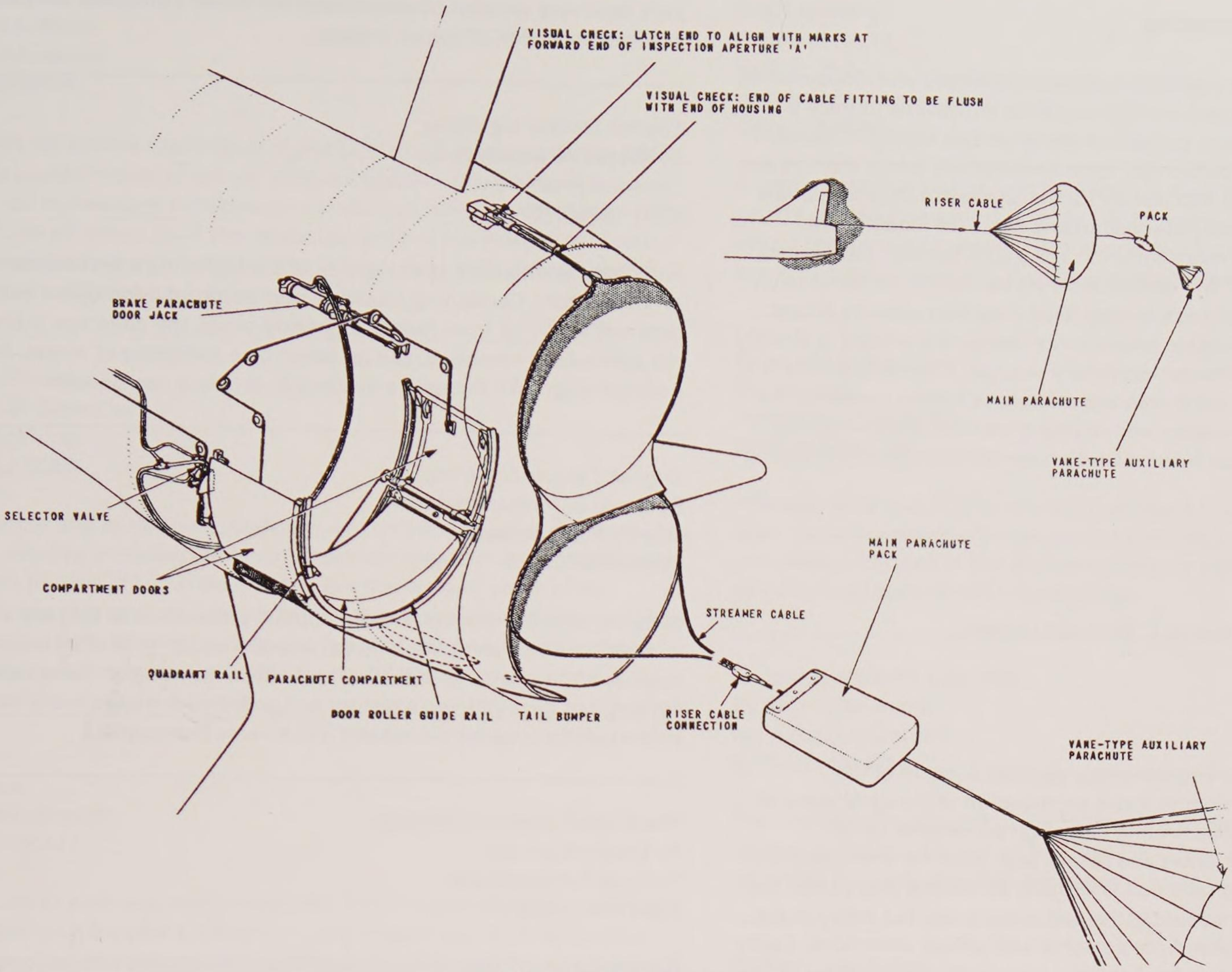


VENTRAL PACK DETAILS

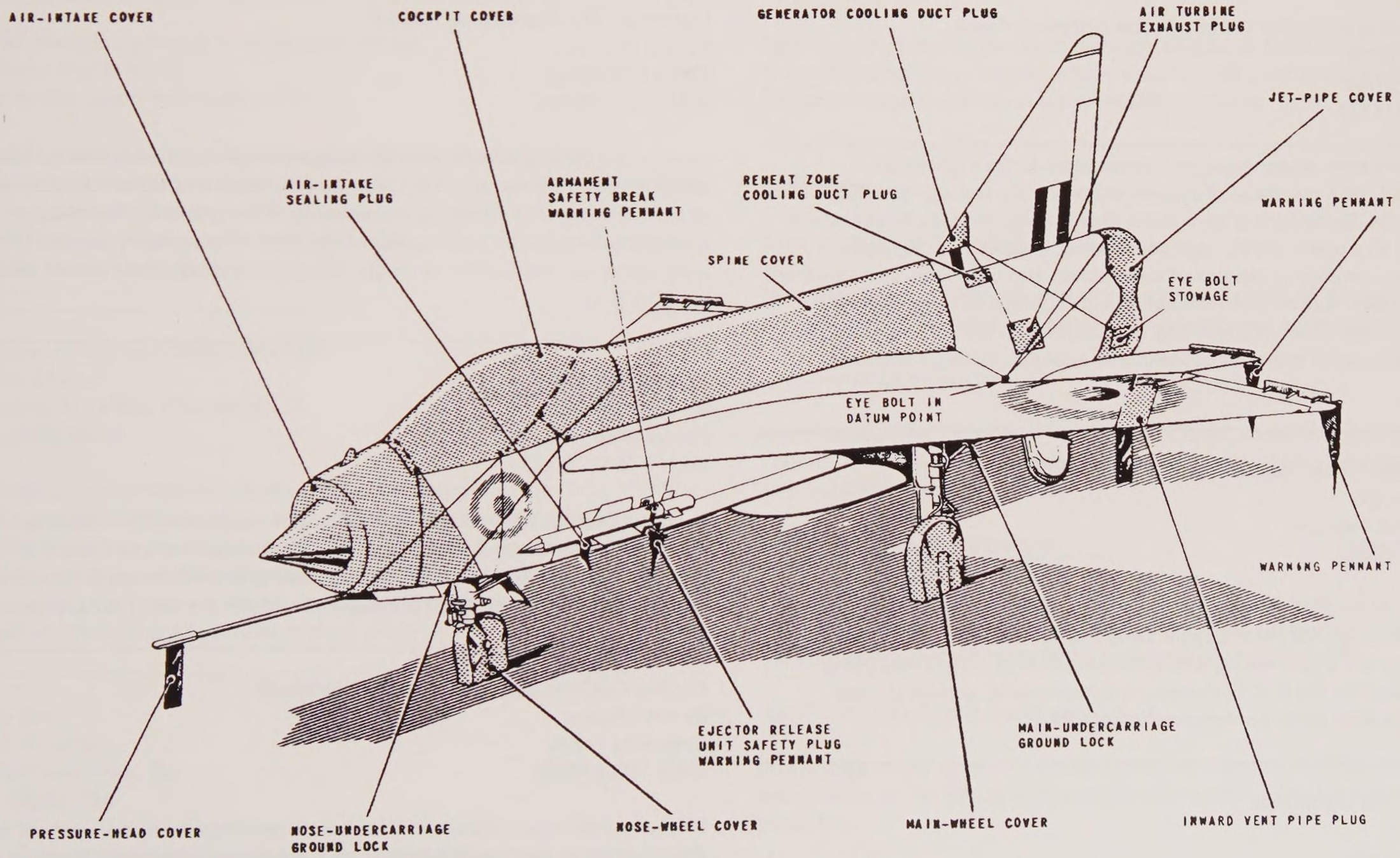
C2588-1



WING TO FUSELAGE ATTACHMENTS



BRAKING PARACHUTE INSTALLATION



COVERS, PLUGS, AND WARNING PENNANTS

Further Reading and Information

It's of little surprise that the Lightning has been extremely well-documented in a variety of media for decades and it would be impossible to trace and record every publication which includes material on this subject. Countless Lightning books have been published, some undoubtedly better than others, and while many have drifted into history (or the shelves of libraries), a few titles stand out as being worthy of mention and these are listed below. Magazine features are even more common and a look through back issues of any particular publication will undoubtedly reveal numerous features on different aspects of the Lightning's history. Web sites are relatively recent additions to the range of available media and although the subject is already very well covered through internet-accessible sources, surprisingly little is of any significant interest with most web site references merely repeating the same widely-available information and relying on the use of poor-quality images. There are a few sites, however, which are certainly worth accessing and these are also listed:-

Books

English Electric Lightning Volume 1. Birth of a Legend
By Stewart Scott
GMS Enterprises
ISBN 1870384784

Author Stewart Scott's huge and extremely detailed account of the Lightning's design and development and examination of the early years of RAF operations, combining fascinating (although sometimes rather bewildering) historical facts, dates and details with personal accounts from former Lightning pilots. Reproduction is virtually all black & white (with the exception of a small colour section at the end of the book) but many of the photographs are rare and taken from personal and official collections. Easily the best and most authoritative book to have been published on this subject although, sadly, now out of print.

English Electric Lightning Volume 2. The Lightning Force
By Stewart Scott
GMS Enterprises
ISBN 1904514103

A second and even larger book on later aspects of the Lightning's development, with coverage of squadron operations through the 1960s and into the 1970s. Same format as Volume One but significantly larger, which contributed to a prohibitively high cover price. Despite this, the book is outstanding, combining masses of information and data with accounts from Lightning crews. A third and final volume is expected to be published, covering the later years of Lightning operations and the aircraft's export history. Sadly out of print but occasionally available through specialist suppliers.

Lightning From The Cockpit: Flying the Supersonic Legend
By Peter Caygill
Pen & Sword Aviation
ISBN 184415355

A selection of detailed personal accounts of flying the Lightning, written by former Lightning pilot Peter Caygill. Only a small selection of black & white photographs but a fascinating and absorbing look at early trials, flying intercepts against the U-2, performance assessments, accidents, and comparisons with other contemporary fighters.

The Last of the Lightnings
By Ian Black
Patrick Stephens
ISBN 1852605413

Excellent celebration of the Lightning's operations with Nos.5 and 11 Squadrons (and LTF) at Binbrook, as related by famous former Lightning pilot (and very capable photographer) Ian Black. Combined with an excellent selection of colour images.

English Electric Lightning
By Martin W. Bowman
Crowood Press
ISBN 1861267371

A comprehensive look at all aspects of the Lightning's development and service history. Combining historical and technical information with personal accounts from former Lightning pilots, the coverage is broad but not particularly extensive, and let down by a scattering of errors. Some good photography but only a few pages of colour reproduction.

English Electric Lightning
By Bruce Barrymore Halpenny
Osprey Publications
ISBN 0850455626

Long out of print, this book was a popular publication at the time of its release but now has only a limited historical value, with relatively poor black & white photo reproduction and only a little colour. Comprehensive coverage of the Lightning's history and activities but later books have subsequently covered the subject much more thoroughly.

The English Electric Lightning
By Martin Bowman
Tempus Publishing Ltd
ISBN 0752417061

A compilation of black & white Lightning photographs with accompanying descriptive text.

Lightning: The Operational History
By Kev Darling
Airlife Publishing
ISBN 185310521X

Author Kev Darling takes a slightly different angle on the Lightning, looking at the service use of the aircraft with an emphasis on the later history of aircraft, tracing their paths to preservation or destruction. Thoroughly readable although the book is relatively small. Photography content is interesting but largely from a single collection and the small colour section is rather poor.

EE/BAC Lightning
By Brian Philpott
Patrick Stephens Ltd
ISBN 0 85177 806 2

Long out of print but well worth obtaining through specialist sources, Brian Philpott's account of the Lightning's development and history is now somewhat dated but certainly interesting and informative. No colour reproduction but some good photographs which are well reproduced.

English Electric Lightning Warbird Tech No.28
By Kev Darling
Speciality Press
ISBN 1580070280

Brief developmental history of the aircraft, accompanying a variety of detail drawings taken from technical manuals, combined with black & white photography.

Lightning Squadrons of the Royal Air Force
By Richard L. Ward
Ad Hoc Publications
ISBN 0946958416

An excellent illustrative exploration of the Lightning's history with the RAF, illustrating a wide variety of colour schemes and unit markings, all accompanied by captions provided by well-known markings "expert" Dick Ward. An all colour book too, although some of the images are black & white originals coloured by computer. An excellent and comprehensive look at the aircraft's service history.

Lightning Strikes
By Martin W. Bowman
Airlife Publishing
ISBN 1840372362

A large-format and all-colour compilation of Lightning images, drawn from a variety of sources including a number of private collections. The quality of some of the images is better than others but the rarity of some of the pictures makes this book truly fascinating. Informative captions are included but the book is unashamedly devoted to the pictures, and provides the reader with a gratifying rush of Lightning nostalgia.

Lightning
By Ian Black
Airlife Publishing Ltd
ISBN 1853100447

Although out of print this small-format all-colour book can still be obtained through specialist suppliers, often for a surprisingly low price. More than sixty pages of brilliant colour photographs, many covering the later years of operations at Binbrook but also accompanied by images from earlier years. Captions are written by well-known Lightning pilot Ian Black.

English Electric Lightning in Worldwide Service
On Target Profile No.13
Aviation Workshop Publications Ltd

Aimed at modellers, this softback book is of interest to all Lightning enthusiasts, comprising a huge selection of colour side profiles which detail the many and varied colour schemes and marking variations applied to the aircraft through its service career. Photography and very informative captions are also included.

Lightning Force: RAF Units 1969-1988
By Fred Martin
Dalrymple & Verdun Publishing Ltd
ISBN 1905414005

Fascinating compilation of (mostly) colour photographs from Fred Martin's private collection, illustrating a wide variety of Lightnings during the aircraft's heyday at the forefront of Fighter Command, and into the later years of operations at Binbrook. Some of the photographs are relatively uninteresting but there are also some unique and fascinating pictures of the aircraft which have not appeared in print elsewhere.

In The Red
By J.T. Kingsley
The Pentland Press Ltd
ISBN 1858217547

Not a Lightning book as such, but author Terry Kingsley's personal accounts of life within the RAF (and beyond) include some excellent coverage of his time flying Lightnings, combined with other fascinating aspects of his career, including a spell with the Red Arrows.

BAC Lightning
Warpaint No.14
By Alan Hall
Hall Park Publications Ltd
ISBN 13630369

A comprehensive look at the Lightning's history combined with a good variety of colour and black & white photographs, together with side profile colour scheme and marking illustrations. Not a particularly detailed account but varied and interesting, despite including a few errors.

Wing of Fame Volume 7
By Jon Lake
Aerospace Publishing
ISBN 185310521X

Although only part of this volume is allocated to the Lightning, more than sixty pages are devoted to the subject, providing a thorough and comprehensive look at the aircraft combining authoritative text with a mix of colour and black & white photographs.

English Electric P1 Lightning
By Roland Beamont
Ian Allan Publications
ISBN 071101471X

The authoritative account of the Lightning's design and development as written by English Electric's Chief Test Pilot. Now out of print but well worth obtaining through specialist suppliers.

Phoenix into Ashes
By Roland Beamont
William Kimber Ltd
ISBN 718301218

Sadly out of print, the personal accounts of Roland Beamont's extensive and fascinating flying career include a section devoted to the Lightning. Difficult to obtain even through specialist suppliers.

Web sites

http://www.lightning.org.uk

The Lightning Association's site includes a good range of information and photography, although it appears to be updated only infrequently.

http://www.lightnings.org.uk

Home page of the Lightning Preservation Group, some interesting Lightning material is combined with news of LPG progress and activities together with links for merchandise, etc.

http://www.lightningpilots.com

The Lightning Pilots site has a slightly misleading title as there is much more available to the reader than only information on air crew. Lots of material on the aircraft including a good mix of photographs.

http://www.lightning422supporters.co.uk

Home page of the Anglo American Lightning Association which includes information on T.5 XS422 and updates on progress with this preservation project.

http://www.binbrook.demon.co.uk

The Lincolnshire Aircraft Preservation Trust site includes information on some different aspects of activities at Binbrook, and information on the two aircraft which the group are currently preserving and restoring.

Possibly one of the most well-known photographs ever taken of the Lightning, but there's no denying that it's also one of the best. F.1A XM171 on the downward leg of a lazy loop over Suffolk, resplendent in the markings of the 'Firebirds' team. (Photo: MoD)

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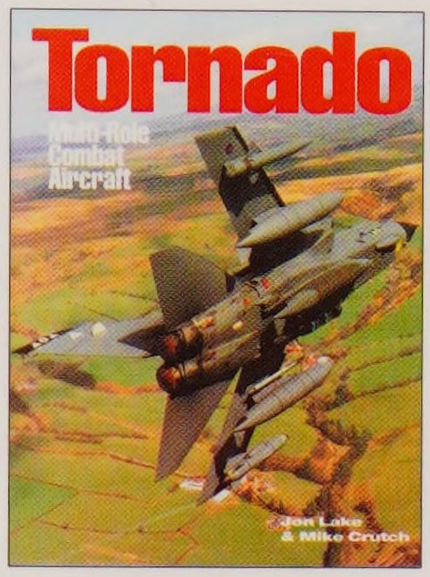

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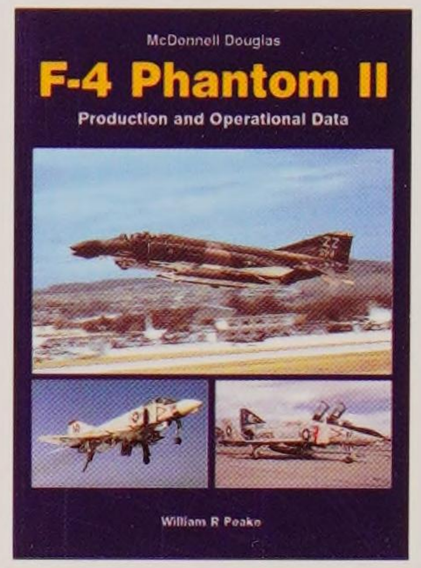

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